A SYSTEM OF DIET AND DIETETICS

EDITED BY

G. A. SUTHERLAND

OXFORD MEDICAL PUBLICATIONS

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Editor's Preface

This book is not a reflection of the fancies of the public on the subject of their food, or of the methods of the individual who believes in an infallible system for the dieting of his patients. Until our knowledge of physiology is more perfect than at present the scientific basis of dietetics must be an unstable one. Nevertheless patients must be dieted, and the physician must be guided by the teaching of history, by experimental physiology, and by clinical experience in the proper regulation of their diet. All that has been attempted in this book is to set down the principles and practice of men who have had special experience of the subjects on which they write.

Each contributor is responsible for the whole of his own section or sections. It may have followed that a certain clashing of views is to be found, but this may be taken as reflecting the divergence of opinion which exists in the profession on the subject of diet. Contributors were asked to give their own views and experiences, rather than to make a collection of all the views of different authorities. Although the book is thereby rendered more dogmatic in tone, it may prove of more value to the practitioner, and serve as a guide in his work rather than be a mere cyclopædia of facts and opinions. At the same time the views of the leading authorities have been included and critically considered. My best thanks are due to all the contributors for the manner in which they have carried out the plan of the book, and for the time and labour they have so ungrudgingly given, often at great personal inconvenience. The readiness with which they responded to my request for assistance has rendered my own task an easy and pleasant one.

The publishers have aided me in every way and have produced a book which is eminently readable. Not even the most ardent student of these pages will be likely to injure his eyesight by their perusal. In the correction of the proofs I have received much assistance from my brother, Dr. C. D. Sutherland.

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Contents

INTRODUCTION

GENERAL PRINCIPLES

CHAPTER I

INTRODUCTION—GENERAL PRINCIPLES

By Sir Lauder Brunton, Bt., M.D., F.R.S.

The subject of food is one upon which countless experiments have been made by myriads of men during thousands and perhaps millions of years. In all parts of the world, from prehistoric times until now, men have been constantly engaged in finding out what things were good for them to eat and what things they had better avoid. The tendency to make such experiments begins at a very early period in life, and the first thing that a baby does with anything new is to carry it to its mouth so as to find out whether it is eatable or not. Nor must we forget that man is the last link in a chain whose beginnings reach to the earliest geological epochs, and that previous to man's appearance on earth those lower animals, from which he is in all probability descended, were also making experiments upon the subject of food.

Some animals developed completely into carnivora living upon flesh alone, like the lion ; while others, like the ox, became entirely herbivorous. Man, however, is not restricted in his diet to either flesh alone or vegetables alone, but can live, when compelled by circumstances, on either of these dietaries or on a mixture of both.

The Indians of the Pampas, for example, are said to live for many months together entirely upon flesh, while many Hindoos are entirely vegetarians. The great majority of men, however, have a mixed diet, a large amount of it being of vegetable origin, but mixed, as circumstances allow, with the flesh of animals killed in the chase, or domestic animals, of birds, fishes, reptiles, insects and molluscs.

Classification of Diets.—Although experiments on food have been going on for ages, it is only within a few decades that the results of these experiments have been classified scientifically. To exemplify such a classification we may take a meal such as is quite common in this country. A man sits down to a steak or chop, attached to which is probably a piece of fat; he has along with it potatoes or bread, and if there is no fat upon the steak or chop he probably has a pat of butter extra. He seasons the meat with salt, and drinks a glass of water during or after the meal. On analysing such a meal we find it contains:

1. Proteins, represented by the lean of the steak or chop.
2. Fats, represented by the fat of the meat or butter.
3. Carbo-hydrates, represented by the potatoes or bread.
4. Mineral matters, like the salt.
5. Water.

Salt is not the only mineral matter which he takes at such a meal, for if the steak or chop were burned to ashes the residue would contain potassium salts, and rarely indeed is drinking water absolutely free from lime, so that in addition to the sodium contained in the salt, he obtains potassium along with small quantities of phosphorus, from the meat and potatoes, and lime from the water.

In order to understand the uses of these different constituents we may utilize the hackneyed comparison between a steam engine and a human body. The motor parts of the steam engine consist of iron; carbo-hydrates in the form of coal yield the motive force; water in the boiler is absolutely necessary for the working of the engine, and its movements are facilitated by the application of oil or fat. If it were not for the question of expense, fat would be the best fuel wherewith to feed the engine, and it is said that in the old days when there was so much racing between the steamers on the Mississippi, the furnaces were sometimes fed with bacon hams, while the captain sat on the safety valve, a proceeding which frequently ended in a tremendous explosion!

In the human engine the bones, which may be likened to the cranks of the locomotive, are mainly composed of phosphate of lime and protein matter. The driving machinery consists of the muscles, which are chiefly composed of proteins, and the energy is supplied partly by carbo-hydrates, and partly by fat, which has also a lubricating function in the body as well as in the locomotive.

Half a century ago it was thought that the energy exhibited by the muscles of the body was derived from combustion of the muscles themselves, and so a large amount of flesh was thought to be necessary, or at least advisable, in the dietary of those who had to undergo great muscular exertion. Men about to enter for athletic contests were then usually fed on beef steaks and beer. Fick and Wislicenus in their celebrated ascent of the Faulhorn in 1865, made some observations which led to the overthrow of the old ideas. The amount of urea in their urine, which served as an index to the quantity of protein waste in their bodies, underwent such a slight increase even during their long continued and severe exertions as to show that the energy necessary for the work which they had done could not have been derived from the destruction of proteins, and that its source must be locked for elsewhere.

Following on these experiments came many other scientific researches which have shown that the protein waste in the body may be likened to the wear and tear of the cranks and wheels of the engine, and that quite a small quantity of protein in the diet is sufficient to supply the waste. But there is a difference between the engine and the body, for the cranks and wheels of a locomotive are quite incombustible under any circumstances, but the proteins of the body, whether they be in the muscles or elsewhere, are capable of combustion and undergo destruction to a great extent during exertion, especially if the supply of hydrocarbons and fats is insufficient for the energy necessary for the exertions.

A careful consideration of the dietaries in use amongst various peoples, in various classes of society, and engaged in various occupations, has confirmed the results of scientific experiments, and it is now universally acknowledged that upon vegetable diet men are capable of very great and long continued muscular exertion. On the other hand the Indians and Guachos can live, as I have said, on an exclusively meat diet. But in both the vegetable and animal diets the five constituents of food which I have already mentioned (p. 4) must be present.

The Hindoo, who obtains most of his energy from the carbo-hydrates of rice, must add a certain amount of fat in the form of melted butter, and protein in the form of millet, a seed which contains a large proportion of albuminoid matter. A certain proportion of salt is also indispensable, and water is so necessary that death from thirst is a great deal worse than death from hunger. Nor is this to be wondered at when we consider that three-quarters of the weight of the body consists of water, and that all our tissues, as Claude Bernard has well put it, live in a fluid medium, namely, the lymph in which they are bathed, from which each tissue draws its nutriment, and to which it returns the products of its waste.

In the same way the Pampas Indians obtain from meat, and the fat which accompanies it, the carbo-hydrates which will yield the energy they need, although with this difference : that they have to consume a quantity of protein far above that which they actually need for the repair of albuminous waste.

The **typical dietary** is that which will give a proper proportion of the different ingredients to supply the needs of the body without any one of them being in excess. Frequently the circumstances under which men live render it impossible for them to obtain the typical dietary, and then they must make the best approach to it that is possible for them. The quantities in a typical dietary, such as the one I have already mentioned, would be :

13 oz. Beef Steak.
3 oz. Butter.
6 oz. Potatoes.
22 oz. Bread.

This quantity is sufficient for twenty-four hours, and it is obvious that few men could eat it at one meal, but they can divide it into two, or perhaps still better, into three similar meals. But typical diet tables are made out on the assumption that the body is all to be worked equally in its different parts. There is, however, a very great difference between the work of the navvy and that of the railway director. The navvy works hard with his muscles, but very little with his brain, while the railway director has very little muscular work, but a great deal of thought and anxiety. The navvy's work consumes a great deal of energy, and his muscles produce much waste, while the brain, which is an incomparably finer instrument, requires much less energy to work it, and produces far fewer waste products. The two may be likened to the steam engines and the chronometer on board a ship. Both are equally requisite for a safe voyage, but, while the engines consume thousands of tons of coal, all the energy needed for the chronometer is that supplied by a few turns of the key which winds it up. The food required to supply energy to the muscles of the navvy is not only much larger in quantity, but different in kind from that demanded by the brain of the director. Muscular work, as I have already said, can be done, to a great extent, on a diet consisting chiefly of carbo-hydrates, with only a very small proportion of nitrogenous matter, but it would appear that brain work requires food in a larger proportion of a nitrogenous nature, and if associated with muscular inaction a great quantity of carbo-hydrates is inadvisable. The comparative effect of a non-nitrogenous and a nitrogenous diet in nervous energy has been well expressed (I think by Butler) in the lines :

> Was ever Tartar fierce or cruel,
> Upon the strength of water gruel ?
> But who withstands his rage and force,
> When first he kills, then eats his horse ?

At the same time, it must be remembered that the amount of fuel required by the brain is very small, and that if much nitrogenous food be taken by a sedentary man, he is unable to utilize it properly and his brain becomes clogged by the products of waste, so that it may, on too rich a diet, be less active and vigorous than on one that is too meagre.[1]

Cooking.—In considering the value of a dietary we must remember that it is not the food which is actually eaten which nourishes the patient but only those portions of it which are digested

[1] A number of other typical dietaries are given by Dr. Hutchison in his excellent book on Food, in which he shows not only the equivalents of various kinds of food but their actual cost.

and absorbed. By prolonged boiling with sulphuric acid and water sawdust may be converted into grape sugar, which is a most useful nutrient, but the digestive powers of a man are quite insufficient to convert the cellulose, of which sawdust consists, into soluble sugar which can be absorbed, and any one feeding upon sawdust alone would certainly die of starvation, although the quantity consumed might contain as much carbon, hydrogen, oxygen and nitrogen as would supply a sufficient dietary provided only they could be utilized.

Various definitions have been given to distinguish man from the lower animals. Plato's definition of "a biped without feathers" was turned into ridicule by Diogenes, who plucked a fowl and then let it loose to walk through the streets of Athens, and the definition of man as a speaking animal does not distinguish him from other animals, many of whom have a language of their own intelligible to each other, although we can understand it as little as we can the clucks of a Hottentot. The definition of man as "a cooking animal" is perhaps the best that has ever been given, for man is the only animal that uses fire. By the process of cooking a number of vegetable products that would be too hard to be readily digested in their native state are softened and made available for food. Protein foods are rendered more palatable and more digestible by cooking and noxious microbes with which the food may be infected are killed by the process so that they cannot set up an injurious kind of fermentation after they have entered the digestive canal. The alterations produced by the cooking of food are partly mechanical and partly chemical. The grains of the starch which is the most important constituent of carbo-hydrate food are broken up, so that they are more readily digested by the digestive juices, and they are also partly converted into soluble dextrine. The albuminous matters are coagulated, and this process not only renders them more easily disintegrated by the grinding action of the teeth but renders them more easily soluble in the juices of the stomach, so that the white of an egg is much more easily digested by the gastric juice when boiled than when raw. It must be remembered, however, in regard to this particular substance, that subdivision is of the utmost importance in digestion, and thus raw white of egg when beaten up may be mechanically so subdivided as to be more soluble than the same substance when hard boiled and swallowed in lumps. One peculiarity of starch is that when thrown into hot water it is apt to form lumps, in whose interior the starch is apt to remain unaltered, but if it be mixed into a thin paste with cold water which is afterwards stirred into boiling water an even mixture is produced. This rule not only holds good for the making of starch paste, but for the baking of bread and the boiling of puddings. In boiling meat the process varies according to the result which is desired. If the soup is the more important, then the meat must be put into cold water and gradually brought up to the boiling point. In this way time is afforded for all the flavouring ingredients of the meat to soak out before the outside layer becomes coagulated and therefore more or less impermeable. If, on the other hand, it is desirable to retain all the flavour in the boiled meat it must be put into boiling water so as to coagulate the surface and retain the flavouring matters as much as possible in the interior. In some parts of the Continent oxen are much used for ploughing and are slaughtered for food only when they are too old to work. The meat is therefore tough and requires prolonged boiling, in which case the soup which is made from it is more important than the meat itself which is afterwards served up with some piquant sauce to render it less insipid and more palatable. On the other hand, when young mutton is boiled in this country for the sake of the meat rather than that of the soup it is put at once into boiling water and thus its flavour is retained.

While cooking is, on the whole, an advantage and renders most foods more palatable and more digestible, there are instances in which the reverse occurs. For example, oysters contain a large quantity of a digestive ferment, enough to digest themselves when they are taken into the stomach, but when they are cooked, not only is this ferment destroyed, but the flesh of the oyster becomes considerably tougher, and so cooked oysters are, on the whole, less digestible than raw. Many plants also contain digestive ferments. This is notably in the case of the pineapple, which is now largely used for making pre-digested foods, and fruits in the process of ripening also contain ferments.

Fresh milk is said to contain no less than seven ferments, some of which split up sugar, others digest proteins and others digest fat. When milk is boiled, the activity of these ferments is destroyed, and some authors have considered that, in consequence of the change in the milk thus produced, boiled milk is apt to produce a form of scurvy. On the other hand, as I have already mentioned, thorough cooking destroys all the microbes that may be present in food and thus not only prevents danger from their causing putrefaction in the intestine, but also prevents the spread of disease by a specific virus such as that of enteric fever.

Change of Diet.—Pawlow showed that the pancreas pours out a secretion whose digestive properties vary with the food supplied. If the animal is fed on flesh the pancreatic juice becomes rich in trypsin ; if the diet be starchy the proportion of amylopsin in the juice becomes greater. Allan Macfadyen and I showed that bacteria have a similar power of adapting the ferment they excrete to the soil on which they grow. But the power of adaptation is more rapid in the animal body than in bacteria, so that it is possible by rapid changes in diet from a completely protein to a completely farinaceous diet, and vice versa, to starve out bacteria, and this is sometimes useful as in the diarrhœa of infants.

Condiments.—The experience of mankind has shown them that food unpleasing to the palate is apt to produce disgust or even vomiting, while palatable food is eaten with pleasure, retained with ease and digested with comfort. But it is only recently that the experiments of Pawlow have demonstrated scientifically that appetizing food, even when it simply passes through the œsophagus without entering the stomach, excites the secretion of gastric and pancreatic juices as well as that of saliva, so that a food which *per se* is less digestible than another may be more readily digested if it is more palatable. In accordance with their experience men have everywhere tried to render tasteless and unappetizing food more palatable by the addition of savoury substances. Thus the Hindoo eats curry along with his insipid rice and the Spaniard eats onions with his bread.

Even when food is already palatable, its taste is heightened by the Englishman who takes mustard with his beef, red currant jelly with his roast mutton or venison, caper sauce with boiled mutton, and apple sauce with roast pork, duck, or goose. It is curious to note that even in condiments there is a tendency to bring about the proper relation between the various kinds of nutriment. Thus onions and strong tasting cheese are not only powerful flavouring matters but they contain a large amount of nitrogen and are thus most useful adjuncts to a dietary of which bread forms a large portion. Fried bacon, herrings, sardines, etc., not only render potatoes or bread more palatable, and butter sauce gives a richer flavour to boiled fish, but they supply the fat which would be deficient in these articles of diet. Red currant jelly supplies the carbo-hydrate which is deficient in the mutton, and the apple sauce seems to counteract the excess of fat in pork, duck, or goose. It would almost seem, too, as if vegetable acids were useful in the digestion of fat because the Italian peasantry who live much upon bread and oil drink sour wine along with them. The palatability of food is not to be regarded as a mere question of gratifying the sense of taste and thus affording pleasure, which some people are apt to look upon as being in its nature sensual and debased. It is a matter of every-day observation that appetizing food, or even the idea of it, is sufficient to make the mouth water, that is to increase the flow of saliva. Saliva is not only a powerful digestive of starchy matters but it tends to stimulate the secretion of gastric juice, and this acts in its turn as a stimulant to the intestine when the gastric juice enters the duodenum and a body is produced in its mucous membrane to which the name of secretin has been given by its discoverers, Bayliss and Starling. This is absorbed and carried by the blood to the pancreas, to which it acts as a stimulant and causes it to secrete an active digestive juice. The activity of the pancreas may, as will be mentioned hereafter, increase the metabolism in the muscles and thus food which from its composition ought to be readily digested, may, if unappetizing, be of very much less nutritive value than other food less easily digestible in itself but pleasing to the palate.

It may be objected that hot buttered toast, which is very palatable, is often found to be indigestible while crisp toast on which butter is spread may be digested with ease. The probable reason of this is that the hot buttered toast is soft and is swallowed without much mastication, while the crisp toast must be well chewed before it can be swallowed. There may possibly be another reason also, viz. that the butter which is spread on the crisp toast becomes more completely subdivided into minute particles, and thus is more easily digested, while the melted butter of the buttered toast runs together more readily into oily masses in the stomach and thus becomes indigestible. When fat is overheated irritating products are apt to be formed from it such as acroleïn, which causes the disagreeable smell from a badly extinguished candle. In cooking pastry some such decomposition occasionally occurs and symptoms of irritant poisoning may occur from eating it. Inferior qualities of butter which have such a strong and disagreeable flavour that they cannot be eaten in the usual way are sometimes used under the name of cooking butter to make pastry, and such butter, although not detected by the palate in pastry, may give rise to sickness and vomiting. On account of such liabilities to cause illness pastry has a bad name, but from my own experience I am inclined to think that pastry, if well made and from the best materials, is wholesome and digestible.

Pawlow's demonstration that savoury food, in the mouth, or even when simply showed to an animal without being eaten at all, will excite the secretion of all the digestive juices explains why the Irish peasantry in time of famine when they were compelled to live on potatoes alone hung up a red herring and pointed their potato at it so as to obtain the suggestion of savoury food. This is probably also the reason why cheese savouries and fruit are eaten at the end of a large dinner which by its amount might overtax the digestive powers of the individual if the digestive secretions did not receive an additional stimulus.

Another function of condiments is to relieve the flatulent distension which often occurs from fermentation in the intestine, especially when large quantities of hydro-carbons are consumed. The substances employed for this purpose are chiefly derived from the natural orders Labiatæ and Umbelliferæ, especially the latter. Thus we find that it is the custom to sprinkle caraway seeds upon cakes and to use fennel, dill and garlic both as a relish and to relieve distension.

Constipation.—Although one would say that the typical diet ought to be one which is entirely digested, is completely absorbed and simply suffices for the wants of the system, yet in practice this is not so. The intestinal canal of man, and of the precursors of man, has not been developed at all under theoretically perfect external circumstances, but has been so developed as to deal with the more or less imperfect foods which could be obtained. In the course of this development the appendix, which is in the horse a large and useful part of the gut, has in man become atrophied and now appears to be only a source of danger, although it is quite possible it may have some function of which we are at present ignorant. The fact that cooking is so common, and that the hard parts of the food which would stimulate the intestine mechanically are softened and deprived of their irritating power, tends to render the movements of the bowel more sluggish, and civilized peoples are very apt to suffer from constipation. I think one may safely say that more than one half of the inhabitants of this country require a certain amount of aid to the action of the bowels. This may be afforded by taking more or less indigestible articles of food in the dietary, so that the whole cannot be absorbed, but must pass through the intestine and be evacuated. In the long practice I had at St. Bartholomew's Hospital, I found that a fortnight was by no means an uncommon period for patients to go without evacuation of the bowels. Many of those lived upon a dietary consisting chiefly of fine white bread, butter and tea, which, of course, left very little residue. But the intestine is not merely an absorbing viscus, it also excretes, and some of the substances that ought to be eliminated by it are apt, in cases of constipation, to undergo absorption and to cause weakness, discomfort and ill-health. For this reason, therefore, it is necessary to have a dietary which is not typically perfect, but contains seeds, husks, or vegetable fibres, and if these do not keep up the peristaltic action sufficiently, they need to be supplemented by excess of sugar, by salts, especially sulphates, or by resins or glucosides having a purgative action. Many people object to the constant use of purgatives, and say that their employment is not natural, totally forgetting that the necessity for them arises from the unnatural mode of life which the patients lead, and the fact of their having well-cooked and soft food from which all the naturally irritating properties have been removed. If such patients were to go back to the habits of primitive man, and live in the woods upon such berries or other edible things as they could pick up, they would probably not want any aperient pills.

Assimilation.—In the intestines the insoluble starches and protein matters are converted into soluble dextrines, albumoses and peptones. These are absorbed and pass in the portal blood to the liver. Albumoses and peptones are deadly poisons if injected directly into the circulation, but they appear to undergo synthesis in the walls of the intestine and to be again built up into albumins, while a great part, at least, of the sugar undergoes synthesis into glycogen in the liver. From this organ the glycogen is gradually removed by conversion into sugar and passes into the blood, by which it is carried to every organ in the body. In 1863, I pointed out that much of it was probably destroyed in the muscles by a glycolytic ferment, which I succeeded in separating, although only imperfectly in isolating. It has only recently been shown, however, that this ferment is probably rendered active by some substances secreted by the pancreas, just as the pancreas itself is rendered active by secretin formed by the duodenum. Thus destruction of the pancreas prevents the utilization of sugar by the muscles, and gives rise to muscular weakness and glycosuria. The albuminous substances formed by synthesis in the intestine are also carried by the circulation to all parts of the body and are utilized either to build up tissue or to furnish energy by being broken down. The products of their decomposition are known by the name of "purin bodies" from a hypothetical substance, "purin," which stands in the same relation to the products of muscular waste that the benzine nucleus does to the aromatic compounds. The final product of muscular waste is urea, and although the name of uræmia was given to a form of auto-intoxication characterized by coma and convulsions, yet urea is now looked upon as not only innocuous, but rather advantageous by enabling the patient to withstand the inroads of certain pathogenic organisms, such as the tubercule bacillus. But very different are the views which are commonly held regarding uric acid. This is looked upon by many as the cause of the pains and swelling, and of the circulatory, nervous, digestive and cutaneous disturbances which are known as gouty. Some writers look upon uric acid as a substance that is either formed in the tissues of the body, or absorbed from the intestine during the consumption of foods which yield it and after its absorption to be either deposited in the tissues or excreted unchanged. This view is incorrect, for uric acid, like other products of albuminous waste, can be destroyed in the body, and the liver seems to be one of the chief places where such destruction takes place. It was pointed out many years ago by Stokvis that if urates be mixed with the pounded liver taken from an animal in full digestion, the urates disappear and are transformed into urea. These results have recently been confirmed by Bokenham and myself as well as by a number of other observers, so that the old view that gout is, to a great extent, due to disordered function of the liver has been rehabilitated. But the fasting liver either does not possess the power of destroying uric acid at all, or possesses it only to a very slight extent, and this power probably varies very much in amount in different species of animals, and in different individuals of the human race. In some persons, it is largely developed, and they have the power of eating great quantities of butcher's meat without any bad effects whatever. Others, again, possess the power to a very slight extent indeed, and a very little excess in albuminous food creates symptoms of discomfort. Although there are no direct experiments to show the effect of alcohol on the transformation of uric acid in the liver, yet it is probable that alcohol lessens the power considerably. At any rate, gout is rare in Russia and in Sweden, where alcohol is consumed to a large extent, but where very little flesh is eaten. Swedes who have come to this country and have taken flesh in addition to alcohol have developed gout, although it was unknown in their family. For persons with inadequate livers, the best dietary is one which contains a minimum of purin bodies, and the use of butcher's meat by them should be to a great extent interdicted. Yet purin bodies are by no means altogether useless. The ashes in a fire are of little use and tend to choke the grate and prevent combustion, but cinders are capable of being utilized and may be very useful indeed. In the same way urea may have some use in the organism though not very much, and may be likened to the ash of nitrogenous tissues. But other purin bodies, uric acid, creatin, creatinin, sarkosin, etc., may be regarded as cinders, and although they contain very little energy they are useful as stimulants. It is these substances which form meat extract and are present in beef tea and soups. They were shown by Pawlow to have a powerful stimulating action on the secretion of gastric juice by the stomach, and thus the practice of beginning a meal with soup is shown to have a good physiological reason. If the feelings of the person who takes beef-tea are to be trusted, it is a powerful stimulant to the nervous system, and frequently removes the depression, weakness and faintness which come on after long continued exertion or abstinence. But though a part of these substances may undergo utilization and destruction in the body, a considerable proportion is secreted unchanged and probably this is the reason why urine is employed in some parts of India, where the cow is a sacred animal and beef-tea impossible to obtain, in the same way that we use beef-tea.

Stimulants.—The experiments of Pawlow, Starling, and others show that when food is taken the stimulation of the salivary glands which it produces is passed on to the stomach, intestines and other organs, the action of each one serving to start the activity of the next. But mankind has everywhere felt the necessity for a stimulant to the central nervous system other than that of food, and in the most diverse countries and from the most diverse plants has obtained stimulants of some kind. These fall into two chief classes: (1) they either contain ethylic-alcohol or some alkaloid having an allied physiological action, or (2) they belong to the purin bodies like the constituents of beef-tea, already mentioned. The alcohol may be present in a more or less dilute form in fermented juices, or infusions, or may exist in a tolerably concentrated form in the distillate which these yield. The general action of alcohol is that of a local irritant, and after absorption it quickens the circulation and lessens the excitability of the nervous system. It thus acts as an anæsthetic both physical and mental, and renders the person who is under its influence less conscious of unpleasant conditions affecting either his body or mind. Painful stimuli such as blows, pricks, cuts or burns are felt less acutely; sensibility to the sensation of fatigue is deadened and mental pain, whatever its origin, may for the time being be abolished. It is this property of temporarily rendering people unconscious of weariness, pain or depression, and of imparting to them a feeling of well-being, hilarity and comfort that has rendered the desire for alcohol so universal. It is evident that such a power may render it a very potent agent either for good or evil. When used in moderation, and on appropriate occasions, I think it is certainly useful, but the very pleasure it gives and the temporary unconsciousness of discomfort or misery which it induces are a temptation to take it again and again in larger quantities, to the destruction of the consumer. The anæsthetic action of alcohol on body and mind was first described by Solomon, who makes the drunkard say in relation to its anæsthetic action on the body: "They have beaten me and I felt it not; I will seek it yet again." And for its effect on the mind he says: "Give wine to him that is of heavy heart, and strong drink to him that is ready to perish that he may drink and forget his misery." Healthy people, as a rule, do not need alcohol, and are better without it; but in the press of circumstances or with advancing years, when the digestive functions become less active, some form of alcohol with a meal is in some persons, I think, though not in all, advantageous. Morphine and cocaine have a similar anæsthetic action to alcohol, but they are more powerful and more liable even than it to abuse and to an even greater extent. The other class of stimulants, viz. those belonging to the purin bodies, are tea, coffee, cocoa, guarana and mate. These do not have the same anæsthetic action as alcohol, morphine or coca, but they stimulate the central nervous system, increase energy and quicken the mental processes.

Excretion.—Some of the purin bodies act as powerful diuretics. Urea has a distinctly diuretic action, but this power is much more marked in caffein, and its allies, theobromin, theocin, which stimulate the excreting powers of the renal tubules. They not only increase the amount of urine, but also of the products of tissue waste it contains, and thus tend to quicken the metabolic processes and stimulate the functions of all the organs of the body.

Metabolism.—We have thus far followed the food through the intestine, the circulation and the excreting organs, but, as I mentioned before, all our tissues live in a fluid medium, namely, the lymph in which they are bathed and not in the blood which circulates through them. The lymph passes through the capillaries from the blood into the lymph spaces. Here it nourishes the tissues, and after it has fulfilled its office it is either re-absorbed into the venous radicals or conveyed by the lymphatics directly into the larger veins. Various substances have the effect of quickening the flow of lymph from the blood into the lymphatic spaces. Amongst these are: egg-albumin, Witte's peptone, extract crayfish, mussels and leeches, nuclein, urea, sugar and salts.

It is probable that a number of others have also this action, and it has lately been found that it is possessed to a large extent by strawberries. The effect of such substances on tissue-metabolism in health and disease is at present unknown, sometimes it may be for good, at other times for harm. I once saw a patient who had some obscure disease which resembled pernicious anæmia more than anything else. Drugs seemed to do little good, but many strawberries eaten all through the day produced very marked benefit. On the other hand I knew a lady in whom the power of strawberries to quicken the effusion of lymph was so great that a single strawberry produced such swelling of the eyelids as almost to blind her.

Salts of potash and soda have a lymphagogic action, and when it is desirable to lessen the exit of lymph from the blood vessels, as in the dropsy of cardiac disease, a diet free from sodium chloride is frequently useful. Calcium salts have an opposite action and lessen the flow of lymph into the lymph spaces. Magnesium appears to have a similar effect, and thus salts of these metals are useful in œdema and localized lymphatic swelling such as urticaria.

Dyspepsia.—The functions of digestion ought normally to be carried on without any pain or inconvenience. On the contrary, satisfaction of the appetite should be a source of pleasure, and digestion should be productive of comfort, but in many instances this is not the case. Weight, distension, pain, flatulence, oppression, palpitation and other discomforts frequently follow the ingestion of food, and these discomforts are generally included under the name of dyspepsia. A great deal of dyspepsia is due to want of proper mastication. Either the teeth are bad and proper mastication is impossible, or the food is hurriedly swallowed without the person taking either the time or the trouble to chew it. The consequence is that little saliva is secreted, starchy foods go into the stomach unchanged, protein foods are imperfectly broken up and are thus more slowly acted upon by the gastric juice. The gastric juice itself is more sparingly secreted from want of the stimulus afforded by the saliva and of the nervous stimulus given by the sapid taste in the mouth. The first link in the process of mastication is thus imperfect and the others follow suit. Here it may be worth while to give a hint about the preservation of the teeth, because many people are under the impression that if they brush their teeth thoroughly they will save them from decay, but this is not the case, because a tooth-brush does not penetrate between the teeth, and it is between the teeth that particles of food stick, especially particles of meat. There they afford a lodgment to microbes and generate acid, and it is between the teeth that caries usually begins. This lodgment can only be removed by the use of a tooth-pick. The movements of the lips act as a brush to the external surface of the teeth, and the tongue does the same for the internal during the day, but during sleep their movements cease and time is afforded for the decomposition of food. A tooth-brush should therefore be used before going to bed, and if milk be drunk either by adults or children at bedtime the mouth should be well rinsed afterwards. But in many cases neither the lips, tongue nor a tooth-brush can thoroughly remove the food from between the teeth, and a tooth-pick should be used. It may be quill or wood, and a very useful and cheap one can be made by simply cutting the end of a lucifer match into a wedge shape. Gobbling the food is very frequent amongst busy people or those who are of active habits, and whenever they think of something to be done, they are apt to eat more quickly than ever, and it is difficult for them to remember that they ought to eat slowly. Sometimes the only way to break them of the habit is to make them count the bites. The advice given by the late Sir Andrew Clark in this respect was very good: "Thirty-two teeth in one mouth, thirty-two bites to every mouthful, and for any tooth that is gone the number of bites must be proportionately increased." The conditions under which a meal is taken greatly affect its digestion. I have frequently had patients say to me: "It is very odd that if I eat a bit of plain mutton and stale bread at home I suffer dreadfully from dyspepsia, whereas if I go out to dinner and eat and drink everything that is put before me I have no trouble at all." The reason of this is evident in the light of the experiments of Pawlow, for when at home the nervous stimulus to the secretion of the digestive juices was absent, while it was present in the case of the dinner outside, and, consequently, in the first case dyspepsia occurred and not in the second.

Depressing emotions and fatigue also interfere with digestion. We have no experiments to show their effect upon the secretion by the stomach or intestine, but their effect upon the secretion of saliva is very marked. Thus, one plan of detecting a thief in India is to make all the suspected people sit round in a circle. Each one is then made to chew a little rice and again spit it out. This process is accompanied by some oaths, incantations or invocations, and the effect is that the fear of detection dries up the secretion of saliva, and the guilty person spits his rice out dry, while the others all put it out moist. Worry has a somewhat similar, though less marked, effect. It was pointed out to me by my friend, Dr. Rayner Batten, that a line of froth along each side of the tongue when it is first put out is an almost infallible sign of worry, and I have proved the truth of this upon many occasions. By attention to chewing and by resting a little while before and after a meal, and by refusing to think at meal times of worrying subjects, nervous dyspepsia may frequently be greatly lessened.

Many cases of dyspepsia depend on the presence of micro-organisms in the alimentary canal which give rise to abnormal processes of decomposition in the food with the production of toxins and gases. Metschnikoff has proposed to cure those cases on the old principle of "setting a thief to catch a thief" and destroying these "wild" and harmful bacteria by the introduction of a large number of "tame" and harmless bacteria. To this latter class belongs the bacillus acidi lactici and Metchnikoff's plan is to give a pure cultivation of this bacillus either in the form of tablets or of milk already soured by its presence.

The dietaries appropriate either for general diseases or for diseases of special organs will be considered under the appropriate headings, but the dietary for a healthy man may be summed up very shortly in the words of Professor Chittenden : "The best dietary for a healthy man is a mixed diet, and not too much of it."

THE EVOLUTION OF MAN'S DIET

CHAPTER II

THE EVOLUTION OF MAN'S DIET

By Harry Campbell, M.D., F.R.C.P.

A knowledge of the changes which man's diet has undergone from early times cannot but be of great value to the physician, whether in enabling him to construct a rational dietary in health and disease or in helping him to interpret the many disorders which result from unsuitable food.

In respect of diet the mammalia fall into three classes—the carnivora, the herbivora, and the frugivora.

The carnivora subsist on an animal diet pure and simple, and this being highly concentrated, their digestive system is correspondingly small in relation to body weight.

The herbivora, of which the horse, the ox, and the rabbit may be cited as examples, subsist for the most part on bulky, unconcentrated vegetable food, such as grasses, leaves, and the like, and have a correspondingly bulky digestive system. Animal food they avoid.

The frugivora, which include animals like the squirrel, the rat, and the monkey, consume vegetable food in its more concentrated forms, such as seeds and nuts. Being generally more intelligent than the herbivora, and gifted also with no inconsiderable prehensile powers, they are able to pick and choose their food more cleverly; and hence securing it in much more concentrated forms, they are provided with a much less bulky digestive system than the herbivora. Their intelligence and nimbleness moreover, often enable them to procure a certain amount of animal food—of all foods the most nutritious. Thus we find squirrels consuming eggs as well as nuts, and many of the monkeys, as also the great apes, supplementing their vegetable food by small birds, eggs, lizards, grubs, and the like.

Man, now essentially a mixed feeder, belongs by virtue of his descent, and as might be expected from his high mental and bodily development, to the frugivora.

FOOD OF THE EVOLVING MAN

Vegetable Food.—The vegetable food of the evolving man was drawn from the following sources:

Seeds.—Seeds constituted his most important vegetable food, on account of the large amount of protein they contain.

Fruits.—When seeds are contained in an exposed brightly coloured, fleshy envelope, they constitute fruits. In the case of most fruits these envelopes, consisting in the ripe state of little more than dilute solutions of sugar and salts, furnish a comparatively small amount of energy, while the contained seeds do not, for the most part, admit of being digested by the mammalia, unless laboriously masticated.

Fleshy roots.—The term "fleshy root" may conveniently be made to include any underground part of a plant (e.g. tuber, rhizome, tap-root) serving as a storehouse of nutriment. The nutrient value of such "roots" depends chiefly upon their richness in starch.

Green vegetables.—Under this head are included leaves and the young shoots of plants. They afford little energy-yielding nutriment, and their chief food value lies in their watery and saline constituents.

Mushrooms, seaweed, the bark of certain trees, gum.—These, though of little nutrient value, must also be included among the foods of the evolving man.

It is important to bear in mind that the products of the uncultivated vegetable kingdom are by themselves totally inadequate to man's nutritive needs. The popular belief to the contrary is perhaps in some measure due to the mistaken notion that fruits like the fig, the date, and the banana grow wild in abundance, and constitute even in their natural state highly nutritious foods; whereas, as a matter of fact, they are, as supplied to our markets, the finished products of a cultivation dating back into an impenetrable past and scarcely to be identified with their wild and barely edible congeners. The sugar-cane and the cocoa-nut are other instances of fruits brought to their present perfection by centuries of careful cultivation: wild, they furnish but a meagre supply of nutriment suitable to man. Even our simian and post-simian ancestors were not able to subsist entirely on the vegetable food with which nature provided them.

One's mind, influenced no doubt by the poets, is too apt to picture early man as surrounded by a profusion of luscious fruits and sweet-tasting seeds, as living in a veritable lotus-land of plenty, where an abundance of delicious food was to be had for the mere trouble of gathering it. But the reality was far otherwise, as is proved by the fact that even now no existing race of man, in spite of most elaborate methods of preparing and thus increasing the nutritive value of its vegetable food, is capable of subsisting on it alone.

Animal Food.—As regards the animal food of the evolving man, it may safely be said that prior to the period of food culture it was acceptable to him in practically any form in which it could be procured. Some kinds would naturally be preferred before others, but there can be no doubt that, at any rate in times of dearth, all kinds were greedily devoured, from mammals, fish, birds, and birds' eggs of every description, to shell-fish, lizards, snakes, frogs, grubs, worms, snails, insects, and caterpillars.

Honey.—This seems the proper place in which to mention honey, inasmuch as it is an animal product; from simian times onwards wild honey undoubtedly afforded a valuable source of nutriment to our progenitors.

FACTORS DETERMINING THE FOOD OF EVOLVING SPECIES

The factors which determine the food of a species are three in number :—

1. The kind of food available, i.e. the character of the local flora and fauna.

2. The specific attractiveness of certain kinds of food, as determined by instinctive prompting for them and by their digestibility.

3. The ability to secure the desired food.

1. **The kind of food available.**—As to this factor nothing need be said here, except perhaps to remark that it is a matter chiefly determined by latitude.

2. **The instinctive liking for certain kinds of food.**—While an instinctive desire for certain foods is peculiar to each species, it will be found that all animals in their choice of food are influenced, consciously or unconsciously, by three main considerations: **the richness of the food in nutrient material, its digestibility, and its taste.** In other words, the tendency of every animal is to seek out food of the most concentrated, and, to it, the most digestible and palatable kind.

The advantages of a concentrated and easily digestible food lie in the fact that the needful amount can be procured and assimilated with the minimum expenditure of energy. Of vegetable foods, seeds and roots are the most concentrated, but of all natural food animal tissue is at once the most concentrated and, by those possessed of the proper digestive organs, the most easily digested, so much so that, given the necessary facilities, even herbivorous species tend to become carnivorous, while the reverse seldom, if ever, occurs: thus in winter the reindeer eats flesh and in seasons of dearth farmers have been known to feed their cattle and even their horses on fish, but the carnivora cannot digest vegetable food unless it has been artificially prepared.

It need scarcely be said that the palatableness of any given food varies for different species: what may be highly palatable to one species may excite disgust in another. Thus there may be species which revel in bitter and sour foods, such as aloes and sloes, but probably the tendency of all mammals, and certainly the tendency of the higher ones, is to avoid what is bitter and acrid in favour of what is sweet and possessed of delicate flavour. Within limits, sourness is tolerated by man, who sometimes manifests an actual craving for sour and even bitter things, such as lemons and various bitter herbs. No doubt the apes in their natural state subsist largely on bitter and acrid substances from which the human palate would recoil in disgust, but we may be sure that even with them the tendency is in the direction indicated.

That man tends to seek out concentrated, digestible, and delicately flavoured food in preference to food that is bulky, indigestible, and acrid, is shown by the directions in which he has modified his food-stuffs by cultivation. If we contrast wild, uncultivated vegetable foods with the corresponding cultivated varieties, we find the former differing from the latter chiefly in containing a smaller proportion of nutrient material and a larger proportion of cellulose, and in being less palatable owing to the presence in them of bitter and acrid substances; whence it is clear that the chief objects aimed at in cultivation have been, on the one hand, to diminish the proportions of the indigestible cellulose and of the disagreeable ingredients, and on the other, to increase the proportion of nutrients—starch, sugar, proteins, and fats. Other things being equal, those vegetable foods which contain the smallest proportions of cellulose (especially of the denser kind) and of bitter and acrid constituents, are the most nutritive and palatable, and therefore the most eagerly sought after. This is an important principle, explaining as it does how the evolving man gradually came to leave certain vegetable foods out of his dietary.

3. **The ability to secure the desired food.**—Obviously the higher the intelligence and the more efficient the bodily equipment for securing food (e.g. that making possible the climbing a tree or the grasping an object), the more successful is the animal likely to be in obtaining its food supply. Thus among the rodents, the stupid rabbit, unable to climb and with little prehensile power, has to be content with a bulky diet of comparatively innutritious herbs, while the more intelligent squirrel, a nimble climber and possessed of considerable prehensile power, is able to procure highly nutritious seeds and a considerable amount of animal food as well. The intelligence and nimbleness of rats, again, enable them to procure highly concentrated and palatable foods, and to place under contribution even those that man has stored for his own use.

All the changes which the diet of our ancestors has undergone since pre-simian times are traceable to the influence of these three factors. We shall see that the food of the great apes and the monkeys is for the most part condensed, consisting of the more concentrated vegetable foods, with the addition of that most concentrated of all food—animal tissue. The fact that many of the monkeys are provided with a large cæcum, and the further fact that all the great apes possess a vermiform appendix, indicating their descent from ancestors having a very capacious cæcum, show that apes and monkeys are alike derived from beings whose diet was more bulky than their own. Evidently with the advance in intelligence and dexterity the evolving primate gradually abandoned the herbivorous for a more concentrated frugivorous diet, becoming also in part an animal feeder. That monkeys and apes, in spite of their great intelligence, are not more carnivorous than they are is probably to be explained by their essentially arboreal habits and their lack of the necessary bodily equipment for securing an abundance of animal food.

THE DIET OF THE PRIMATES BELOW MAN

Zoologists include under the Order Primates, besides man himself, the lemur-like animals (Lemuroidea) and the man-like animals (Anthropoidea). The latter include the great tailless apes (gorilla, chimpanzee, orang, and gibbon), of all animals the nearest akin to man, and the monkeys, of which the baboons are the highest representatives and the marmosets the lowest, the latter, as Huxley pointed out, being actually farther below the great apes than the great apes are below man. Nuttall has shown that, tested by the blood, the great apes are the most closely allied to man, the baboons standing next closest of kin, while the lemuroids give no indication of any blood relationship. The lemurs are the most carnivorous of the primates, while the guerezas and the langurs are the most vegetarian.

The monkeys.—Summarizing our knowledge of the diet of the monkeys we may say that while it is in the main frugivorous it is also partly animal. Their animal food includes birds, birds' eggs, mice, lizards, frogs, shell-fish (on which certain species subsist almost entirely), grubs, scorpions, centipedes, and insects. Honey is devoured by some of the baboons and by the guenons, and gum by the baboons and probably many other monkeys. Their vegetable food comprises fruit, seeds, roots, tender shoots, and leaves. All the monkeys appear to rob plantations when they get the chance. The fact that baboons are known to dig up roots and search under stones for insects and grubs is of interest as showing the high degree of intelligence they bring to bear on the food quest, and as suggesting that man's precursors began early to use their hands in these ways. It is also worthy of note, in passing, that several varieties of monkeys employ stones and other missiles against their enemies : baboons hurl stones ; guenons repel intruders with stones and branches of trees ; there is even evidence that pitched battles may take place among certain species of langurs for the possession of feeding grounds—probably the chief *casus belli* throughout man's entire history.

The great apes.—Coming now to the diet of the great apes we find that, as in the case of the monkeys, they are mainly frugivorous—their vegetable diet, that is to say, consists chiefly of vegetable food in its more concentrated forms—though they are also to some extent animal feeders. The gorilla is apparently the most, and the orang the least, carnivorous of the great apes. It seems likely that animal food is chiefly sought after by them when vegetable food is scarce: insects, grubs, vermin, lizards, snakes, rats, mice and other small mammals, birds' eggs, and birds are then devoured. We have seen no mention of their consuming fish in their natural state, yet it may well be believed that they do so upon occasion. Nor have we met with any evidence of their eating honey, though seeing that this valuable and toothsome food enters into the dietary of many monkeys which are much below the apes in intelligence, it is scarcely to be doubted that the latter indulge in it when opportunity offers. Their vegetable food consists, like that of monkeys, of seeds, fruits, young shoots and leaves, succulent barks, and possibly also of roots and gums, though of this there is no direct evidence.

One definite conclusion we can draw from the study of the vegetable food of the apes—namely, that since much of it is from its coarseness and acridity unfit for human consumption, the coarser and less palatable varieties must have been gradually discarded by the evolving man as the means of procuring other and better kinds increased.

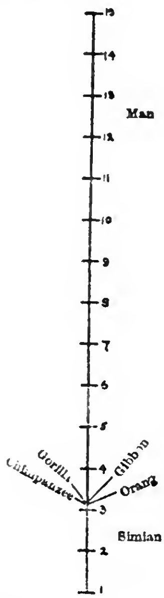

FIG. 1.—The Evolution Ladder, showing Man's Ascent from the Ape.

The third rung, 3, represents the position of man's primitive anthropoid precursor, with a cranial capacity of 300 c.c. The highest rung, 15, represents the position of modern civilized man, with a cranial capacity of 1,500 c.c. The dignity of manhood was attained, it is assumed, at the tenth rung—i.e. when the cranial capacity was 1,000 c.c. The simian stage, or stage of the man-like apes, extended from the third to the fifth rung; the homo-simian stage, or stage of the ape-like man, from the fifth to the tenth; and from the tenth rung onward is represented the stage of man.

To summarize then: the diet of the primates below man (i.e. of the monkeys and the great apes) is mainly vegetable, and so far as these animals are vegetable feeders they are essentially frugivorous, their food consisting, not mainly as in the case of the herbivora, of grasses, leaves, and young shoots, which in order to afford a sufficiency of nutriment must be consumed in large quantities, but of the more concentrated fruits and seeds: in short, the diet of these primates, as of all highly intelligent animals, is a concentrated diet, consisting of concentrated vegetable foods and to a less extent of the yet more highly concentrated animal foods.

THE DIET EPOCHS

The dietetic career of the evolving man from simian times onwards has been characterized by three signal advances, each of which has greatly augmented his supply of food. Before considering these a word may be said as to a convenient method of denoting the successive grades, or stages, in man's evolution from his simian ancestors. This is by reference to cranial capacity (*see* Fig. 1). Assuming the latter in the common ancestor of man and the great apes to have been 300 c.c., and in the average European of to-day to be 1,500 c.c., we may mount upwards to the 1,500 c.c. by successive grades of 100 c.c., or, striking out the noughts, from 3 to 15. Thus we may speak of a third-, fourth-, and fifth-grade *Simian*; of a sixth-, seventh-, eighth-, and ninth-grade *Homo-simian*; and of a tenth-, eleventh-, twelfth-, thirteenth-, fourteenth- and fifteenth-grade *Man*.

The **first great dietetic advance** made by the evolving man occurred (say, at the tenth grade, *see* Fig. 2) when the genuine hunting and fishing stage was entered upon—when man began, i.e. systemically to employ artificial aids in capturing his animal food, and thus came greatly to increase its supply, and to be correspondingly less dependent upon vegetable food. Until he had in this way developed into a skilled hunter and fisher, he could procure none of the larger game, except by an occasional lucky chance, and only a very limited quantity of fish.

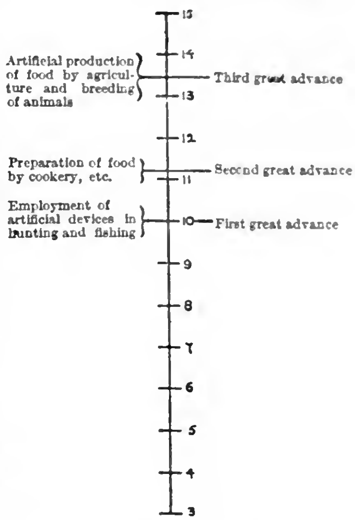

Fig. 2.—Diagram indicating the Three Great Dietetic Advances made by Man in the Course of his Philogeny.

The **second advance** came (say, soon after the eleventh stage) when he began to subject his vegetable food to preparation, such as sun-drying, grinding, maceration, and above all cooking, the last process probably not being adopted until after he had learnt to employ the three more primitive methods. The employment of cookery, by converting the innutritious into the nutritious, led to a considerable increase in the supply of vegetable food and opened the way to the cultivation of grain and roots otherwise comparatively useless.

The **third advance**—preceded by the minor step of learning the secret of storage against seasons of dearth—occurred when man began (at about the thirteenth stage) to cultivate the plants and to breed the animals he had come to value. Once he had fairly entered on this stage he in one bound increased his food supply a thousandfold, and became able to multiply and progress in a manner hitherto quite impossible.

We are now in a position to tabulate the following epochs and periods. Thus :—

1. The pre-cookery epoch.—From the ape stage to the invention of cookery, 3rd–11·25th grade.	The Simian period (3rd–5th grade). The Homo-simian period (5th–10th grade). The Early Hunting period (10th–11·25th grade).
2. The pre-cibicultural cookery epoch.—From the invention of cookery to the introduction of agriculture and the breeding of animals for food (11·25th–13·5th grade).	
3. The cibicultural epoch.—From the time man began to produce his food artificially to the present day.	The period of Migratory Agriculture and The period of Stationary Agriculture { Early. Late.

These diet periods we will now consider seriatim.

1. THE SIMIAN PERIOD

Our study of the food of the primates enables us to draw the following deductions regarding that of our simian precursors (3rd–5th grade), beings akin to the surviving great apes. The descendants of animals of herbivorous habits, they were themselves in the main frugivorous, subsisting chiefly on concentrated vegetable food, such as seeds, nuts, and berries, as well as on the less concentrated luscious fruits, leaves, and young shoots, and probably also on roots (which were scratched or pulled up), gum, honey, and the bark of certain trees. Much of the vegetable food, owing to the large admixture of cellulose, was dense and coarse, and of a kind which would be highly disagreeable to the palates of their human descendants from the predominance of sour, bitter, and acrid principles. The animal food consisted of grubs, caterpillars, ants, ants' eggs, snails, insects (e.g. spiders, grasshoppers, beetles, and the like), reptiles (e.g. lizards, snakes), birds, birds' eggs, the smaller mammals (e.g. rats and mice) ; possibly also of shell and other fish from the lakes and streams.

2. THE HOMO-SIMIAN PERIOD

The next period (5th–10th grade) saw the simian pre-human struggle upwards from ape to man. He gradually spread from his cradle-land in Southern Asia or Northern Africa over the then existing Indo-African continent, leading, we may conjecture, a comparatively stationary or non-nomadic life, and subsisting chiefly on raw vegetable food. As his intelligence increased, however, and with it the means of procuring animal food, he became less and less a vegetable feeder and more and more carnivorous, though he was at this time able to secure only the smaller animals and a limited quantity of fish, being as yet without hunting weapons and fishing tackle. With this animal addition to his food he naturally came by degrees to abandon, and thus to lose the power of digesting the most indigestible and unpalatable forms of his vegetable supply.

3. THE EARLY HUNTING PERIOD

The hunting period (10th–11·25th grade)[1] may be said to have begun with the employment of special weapons and devices in hunting and fishing such as are employed by extant pre-cibiculturists. Until these had been devised none of the larger animals and only small quantities of fish could be secured as food. While, therefore, the diet of the homo-simians was always becoming more and more animalized as their evolution advanced, it was not until he had become an adept in the arts of the chase that the evolving being (whom we may now suppose to have attained the dignity of manhood —the invention of hunting and fishing appliances and the contriving of trapping surely constituting a title to this distinction) became perhaps even more carnivorous than vegetarian. What

[1] Though the writer dates the commencement of the hunting period from about the 10th stage of man's evolution, he has no doubt that man had attained to considerable skill as a hunter long before this. He probably began to fashion hunting and other implements quite early in the homo-simian period.

makes this probable is the fact that the diet of the extant pre-cibiculturists consists on an average of equal parts of animal and vegetable food. (We exclude from consideration the Esquimaux who live under exceptional climatic conditions.) Now all these people are skilled in cookery, and are able by its means greatly to increase their supply of vegetable food; from which we may conclude that without the aid it affords they would of necessity be more carnivorous than vegetarian, and we may fairly assume that such was the case with man in the period immediately preceding the advent of cookery. It must not, however, be forgotten that the introduction of cookery led our progenitors, as we have just seen, to abandon many of the coarser and less palatable varieties of vegetable food, and that the pre-cookery semi-human was thus presumably more capable of subsisting on raw uncultivated vegetable food than is any pre-cibicultural man extant, and this capacity may have been handed down unimpaired as late as the early hunting period.

Another effect of the enhanced skill in hunting was that it enabled man to spread into regions which without it would not have provided him with sufficient food: we may, in fact, date his dispersal far and wide over the earth from the beginning of this period, though it is quite possible that no very general migration took place until he had learnt to prepare his vegetable food artificially and so had greatly increased its supply. There can be little doubt that the ability of man to spread over the earth was a question of food supply rather than of climate.

During the whole of these pre-cookery periods the evolving man had, like all other vegetable-feeding mammals, to subject his vegetable food to thorough mastication. All raw vegetable foods, except the luscious fruits, of which the nutrient constituents consist mainly of soluble salts and saccharides,[1] require prolonged mastication in order that the non-digestible cellulose chambers in which their starch, protein, and fat are contained may be broken up. Even herbivorous animals, which are provided with special means of digesting cellulose, need to

[1] The term "saccharide" is used as synonymous with "carbo-hydrate."

masticate their food laboriously if it is to yield its full complement of nutriment. This is testified by the phenomenon of cud-chewing and by a variety of other facts, such as the frequency with which grains of corn pass intact through the alimentary tract in the case of old horses with worn-down teeth, or of younger horses given to bolting their food.

It is therefore evident that throughout these periods the masticatory apparatus of our progenitors must have been put to constant and arduous use, with the result that all the starch ingested was thoroughly masticated. Now inasmuch as the intake of starch in those far-off times, before man had learnt to cook or to improve his vegetable food by cultivation, was limited, it is obvious that most of it was digested into dextrine and maltose within the mouth, and that comparatively little passed into the stomach in the crude state. It will thus be seen that *until the invention of cookery the stomach of the evolving man had but little acquaintance with undigested starch,* saccharide material entering it for the most part in the soluble form, either as grape sugar, fruit sugar, cane sugar, or, finally, as the products of salivary digestion, i.e. dextrines and maltose.

4. THE PRE-CIBICULTURAL[1] COOKERY PERIOD

The importance of the **invention of cookery** relates almost entirely to its **effect on vegetable food.** It is probable that before man learnt the art he had already begun to prepare his vegetable food in other ways, as by sun-drying, grinding, and burying-processes which in many cases increase its digestibility, and by maceration, whereby poisonous and acrid ingredients may be got rid of. When he learnt to subject it to these various methods of preparation, but still more when he began systematically to apply artificial heat to it, i.e. to cook it, he greatly augmented his supply, for there are many highly nutritious vegetable substances which in the unprepared state, either on account of the large proportion of dense cellulose they contain or of their admixture with noxious substances, are of little or

[1] The term "cibiculture" is convenient as signifying the cultivation of food, animal as well as vegetable.

no food-value to him, but which by cooking and other means can be converted into valuable nutriment. Hence with advances in the art of cookery—and it is surprising to what a degree of excellence that art had attained in the latter part of this period—the supply of vegetable food steadily increased, and the hunter found himself to some extent released from the chase and freer to devote himself to other pursuits. These changes continued throughout the periods under consideration, until vegetable food came to constitute one-half, or more, of the total dietary.

The chief effect of cooking on vegetable food is to cause the starch granules to swell up and rupture the non-digestible cellulose chambers in which they, as well as the protein and fats, are contained. It is for this reason, and also because starch is more digestible cooked than raw, that cooking greatly adds to the digestibility of all vegetable substances containing an abundance of cellulose, while at the same time it relieves the organs of mastication of much of their work. The systematic adoption of cookery, therefore, led man to subject his vegetable food to less mastication than before, with the result that its starchy ingredients underwent so much the less oral digestion, and inasmuch as with the advent of this period more starch was consumed than previously, it is clear that more undigested starch entered the stomach than had hitherto been the case.

The abandoning of, and the corresponding loss of power to digest in the raw state, the less digestible and less palatable kinds of vegetable foods which characterized the homo-simian and early hunting periods, went on with accelerated rate after man had once begun to subject his food to artificial preparation. Thus he came to depend less and less upon raw vegetable produce and finally to limit himself to the easily digested kinds only.

Cookery

The antiquity of cookery.—There can be little question that one of the earliest uses to which man put fire was to cook his food. Cookery was doubtless in the first instance practised in a desultory fashion, and not until it was employed systematically can the genuine period of cookery be said to have begun. The most primitive peoples now living cook their food, and that they have for ages done so is shown by the fact that, though now widely separated both ethnologically and geographically, they employ identical methods of cookery : thus the aboriginal Australians and Californians, the Bushmen, the Andamanese, and the Ainus all know how to extract noxious principles from their vegetable foods, and all employ underground ovens. These ovens, as well as the methods employed for extracting noxious ingredients, are so remarkably alike amongst present-day pre-cibiculturists as to make it practically certain that they had a common origin, and the circumstance that some of these peoples, e.g. the Australian natives and the American Indians, were for long ages cut off from the rest of the world, points to their having taken their methods of cookery with them at that remote time when they first migrated from a common centre ; nor can there be much doubt that those methods had been in use long before that migration took place.

The evolution of cookery.—The simplest method of cooking, and doubtless that first employed, is by holding the food over, or actually placing it on, the fire, or in hot embers. Vegetable food does not as a rule allow of this process, because of the readiness with which it burns, but some kinds, e.g. roots and large seeds, may be roasted in hot embers, and existing pre-cibiculturists sometimes resort to this method.

The first great advance in the art of cookery was the invention of the underground oven, by means of which food, especially the vegetable varieties, can be cooked much more efficiently than by the primitive methods just described. Oven-cookery was probably suggested by the custom, still occasionally practised, of kindling a fire over the food to be cooked. It was but a step from this to digging a hole in the ground, into which to put the food, and, then making a fire over or around it. The next step, we may assume, was to heat the walls of the hole by means of a fire and, having raked out some of the ashes, to place the article to be cooked inside and then cover it up in order to retain the heat. Finally, we arrive at the most advanced phase of underground oven-cookery, i.e. by means of heated stones. These and the food are placed in alternate layers within the oven, forming a pile above the level of the ground, the whole being covered with matting, leaves, grass, or the like. This method may be described as "stone-baking." Generally, however, the oven is lined with, and perhaps also the layers of food and stones are separated by, some vegetable substance, so as to generate steam, which then becomes the active agent in the cooking, a method which may be described as "stone-steaming," and a very admirable one it is. Without metals or pottery which among us could devise a better?

The next great development in the art came when man discovered how to boil water. In some parts of the world, e.g. in the neighbourhood of the once famous terraces of New Zealand, nature has provided boiling pools which afford a ready means of cooking food, and the Maoris do in fact use them for this purpose. The food is placed in a basket or netting, which is lowered into the water by means of a string made fast to some fixed object, and there left until it is cooked. It was not, however, until a comparatively recent period, probably not until long after he began to employ underground ovens, that man taught himself to boil water wherever he might be. That the method of boiling food post-dated that of baking or steaming it in ovens is shown by the fact that certain pre-cibiculturists have not yet attained to it. Such is the case with the Australian aborigines, and their ignorance of the device seems to show that it was not thought of until late in the cookery period. The Fuegians and Bushmen are also said to be unacquainted with it.

The great obstacle to the boiling of water which presented itself to primitive man lay in the fact that he possessed no vessel capable of resisting the action of fire. Pottery, it should be remembered, is of quite recent introduction: it is unknown to present-day pre-cibiculturists and belongs, in fact, to the cibicultural period. With the exception of shells, the only fireproof vessels in pre-pottery days were those made of hewn stone, but the making of such vessels entails great labour, and they do not appear ever to have been widely employed for cookery of any kind. How, then, did man first boil water ? Before answering this question let us first consider what vessels he employed for holding water. The most primitive were those fashioned by nature, such as segments of gourd-rind, the shells of shell-fish and eggs (e.g. those of the ostrich), the bamboo cane, and even the human skull. At a later stage he learnt to make vessels of skins and closely plaited rushes. It is obvious that none of these can be used as saucepans, though the Botocudos are said to have boiled water in bamboo vessels held over the fire. A water-tight vessel which does not admit of being placed over a fire may, however, be used for heating water by filling it with water and then dropping in heated stones. This ingenious method—no doubt the earliest—was widely practised among primitive peoples and is still employed by some of the pre-cibiculturists, such as the Californians, the Esquimaux, and the Andamanese. It was in use also in isolated parts of Europe until within comparatively recent times. In Ireland hot stones were used for warming milk in the seventeenth century, and in Finland in the making of beer as late as the eighteenth century. In the earliest times the vessels most frequently employed for stone-boiling by the Californians, the Fuegians, the Kaffirs, and the native Australians were made of closely plaited rushes.

Cookery first employed for vegetable foods.—The question whether at the beginning of the cookery epoch the process was employed equally for animal and vegetable food, or for the one more than for the other, is of great interest. We believe that it was in the first instance chiefly, if not entirely, applied to vegetable food. There were many reasons why man should cook the latter, and few inducements for him to cook his animal food. We have seen that cookery promotes the digestibility of all vegetable substances, the luscious fruits only excepted. On animal food it has no such effect : true, the connective tissue is gelatinized by heat, but on the other hand, the proteins are coagulated and, if anything, rendered less digestible than in the raw state. Why, then, should early man have been prompted to cook his animal food ? It is true that cooked flesh is to us more savoury than raw, but it is very doubtful whether it was to him, and whether he would be at great pains to cook it merely for the sake of improving its flavour. He was a hunter and largely carnivorous for long ages before he learnt to cook at all, and what he strove after so eagerly we may be sure he devoured with no less avidity, and with all the savage relish of the genuinely carnivorous animal.

Strange to say, Cuvier held that man became an animal feeder by virtue of cookery, and quite recently the same view has been put forward by Dupont, Boidier, and Berge. "It can be asserted with complete assurance," observes the last-named writer, "that if man has been able to include flesh foods in his dietary it is essentially because he has been enabled to submit them to the action of fire. Unless cooked, these foods are very difficult of assimilation (sic) and cannot therefore enter into his dietary." This view is altogether untenable, for not only is raw animal food without question very readily assimilable, but man was a hunter long before he employed cookery.

As further suggesting that cookery was in the first instance mainly, if not exclusively, employed for vegetable food we may cite the fact that all the surviving pre-cibiculturists (with the exception of the Esquimaux, who are necessarily almost entirely carnivorous) spend much time and care in cooking their vegetable food, often putting it through processes truly amazing in their complexity, while their animal food is either eaten actually raw or cooked in an altogether casual and haphazard fashion. Not less significant is the fact that the practice of eating raw, or semi-raw, animal food can be traced down to modern times in peoples who have entered upon the cibicultural stage. Thus the Andorobos of Africa sit round the carcass of their quarry and devour it raw, while other cibicultural African tribes are known to drink the blood of animals, both living and dead, a practice which is even to this day not unknown in Europe. We have it from an eye-witness that a Swedish sportsman, having shot a stag, put a flask to its cut throat and, filling it, drank off the blood with gusto, and the custom clearly survives among deer-stalkers in Scotland, when they drink to the words "more blood" a jorum of whisky by the body of the quarry.

Nor must we forget that neo-man does not refuse raw animal food: oysters and other shell-fish are eaten raw, raw ham is a common article of food on the continent, and a dish in which raw steak is the chief ingredient is by some gourmets greatly esteemed. Moreover, there is abundant evidence that the most delicately nurtured will in extremity devour raw animal food with avidity.

THE FOOD OF EXISTING PRE-CIBICULTURISTS

There still survive many peoples who are genuine pre-cibiculturists, i.e. who neither cultivate the vegetable kingdom nor breed animals for food. They go naked, or nearly naked, spend most of their time in the food quest, are without metals or pottery, and ignorant of all but the most rudimentary arts. As might be expected they are found in the most inaccessible parts of the world, where they have for long ages been more or less isolated from their fellows. They include the aboriginal Australians, the Andamanese, the Californian Indians, the Esquimaux, the Bushmen of South Africa, the Veddahs of Ceylon, and the Hairy Ainus.

Animal Food

With the exception of certain kinds which are to some tribes taboo for superstitious reasons, every species of animal food may be said to be acceptable to pre-cibicultural man.

Grubs, insects, and reptiles.—Grubs are eagerly sought after, nor are they to be despised as sources of nutriment, as they often attain considerable dimensions. Worms, scorpions, moths, grasshoppers, sandflies, crickets, locusts, centipedes, caterpillars, and pediculi are also consumed. White ants are in great demand and considerable ingenuity is displayed in catching these and other insects. The Californians catch ants by placing upon the ant-hill a piece of bark or fresh hide on which the ants swarm and from which they are brushed off into a bag: grasshoppers are caught in nets, or by being driven into pits, either by beating the surrounding grass or by setting it on fire. Frogs, toads, lizards, and snakes are, when available, devoured by all pre-cibiculturists.

It will be observed that we found all these varieties of animal food entering into the dietary of the great apes.

Terrestrial mammals.—The most notable mammal on which the pre-cibiculturist feeds is man himself, but on the whole he is but little addicted to cannibalism. Big game forms his chief supply of animal food, deer, antelope, and elk being the favourite objects of the chase. The inland tribes of Australia depend mainly for their animal food upon the kangaroo and other marsupials. As might be expected from the difficulty in procuring them, the carnivora seldom serve as food, though the Bushmen are said to eat the lion and the hyæna.

The methods employed for hunting game would afford material for a large volume, and cannot be gone into here.

Aquatic mammals.—Among the Esquimaux the seal, the walrus, and the whale constitute the chief sources of food, while the Fuegians at the other extremity of the same continent live largely on seals and porpoises.

Birds.—Owing to the difficulty in procuring them, birds do not enter greatly into the dietary of pre-cibiculturists.

Fish.—All pre-cibicultural maratime tribes, such as the Fuegians and the Ainus, subsist largely on salt water fish, while inland tribes living near lakes and rivers procure fresh water fish, of which the most important, especially among the Californians and the Esquimaux, is salmon; there are times when the rivers of California are said to be actually "darkened with the swarms of salmon."

Shell-fish.—Both fresh water and salt water shell-fish, particularly the latter, are eagerly sought after. Clams are considered a great delicacy by the Californians, who display much skill in diving for them. The Fuegians also are expert divers, both sexes diving for sea-eggs. It is curious that the succulent oyster should be taboo to the aboriginal Australians.

Methods of preparing animal foods.—Among the pre-cibiculturists animal food is, as we saw when considering the development of cookery, not infrequently eaten raw, and it is rarely more than very partially cooked. The Esquimaux indeed derive their name from their raw-flesh-eating propensities : frozen flesh they never hesitate to devour raw, and they consider the raw viscera of the ptarmigan a great delicacy. The Veddahs frequently devour raw animal food, and in any case cook it but slightly, often merely scorching it over the fire. The Fuegians readily eat raw fish : one of them, when given a live fish, instantly killed it by biting it near the gills, and then proceeded to devour the whole. Among the native Australians raw flesh is not objected to, though when time permits it is subjected to slight roasting.

Grubs and insects are frequently eaten in the raw state. "It was not a pleasant sight to see an Australian woman divest of wings and legs the gigantic fly (cicula) and then gobble it alive."

Animal food is sometimes boiled by the Esquimaux and the Californians, and occasionally more elaborate methods of cooking it are resorted to. Not infrequently it is eaten "high." The Esquimaux sometimes consume it in a state of actual putrefaction, when it is known as "mikiak" ; one dish highly esteemed by them consists of "rotten seals' heads."

Insects are dried in the sun, after which they can be stored for some time. Flesh food and fish are also sun-dried and stored. Another plan, widely adopted, for preserving animal food is by smoking it ; the Californians store large quantities of smoked salmon. The Veddahs employ honey as a preservative.

Vegetable Food

Roots.—Root-digging is an important industry among the pre-cibiculturists and furnishes a surprisingly large store of food. The task of digging falls to the women, and since the sole implement employed is a fire-hardened stick, it is, as may be imagined, no light occupation.

Small seeds.—Of the various kinds of vegetable food collected by the pre-cibiculturists perhaps the most interesting are grass seeds, for it was doubtless the recognition of their high nutritive value that led to the cultivation of cereals (maize, wheat, barley, oats, rice, and millet), a step which was in all likelihood a necessary forerunner of civilization. It is probable that all the pre-cibiculturists collect grass-seeds, when these are procurable: certainly the native Australians and Californians do, the former harvesting the seeds of silver grass, bower grass, and millet, and the latter (among others) those of sand grass, bunch grass, wild rice, oats, and wheat.

The larger seeds and nuts.—Among the larger seeds may be mentioned those of the oak (acorns), sunflower, cactus, watermelon, and several species of pine and leguminous plants. Acorns entered into the dietary of the early European races, and are to this day largely consumed by the Californians and the Ainus. Among the former the acorns are gathered by the squaws and the old men in deep conical baskets, and Powers describes how the invariable sound which salutes the ear as one approaches a village "is the monotonous thump thump of the pestles used by the patient women in pounding the acorn." So highly do the Californians prize the acorn that they dedicate to it a special dance.

Fruits.—Many varieties of luscious fruits and berries are eaten.

Green vegetables.—These are chiefly valued for their component salts and water. The aboriginal Australians consume large quantities of the "pig's face" and sow-thistles, which are highly prized for the sake of the large amount of salt they contain. The Californians eat much green food in the spring, especially clover, the early gathering of which is celebrated by the "clover dance:" we read how a whole village may sometimes be seen squatting in a clover meadow plucking the blossoms. The wild lettuce is also a favourite with them.

Fungi.—Though of little nutritive value fungi, when available, appear to be eaten largely by the pre-cibiculturists.

Seaweed.—Those living near the sea coast eat certain kinds of seaweed.

Gum.—Natural vegetable gum is freely partaken of by some pre-cibiculturists, e.g. the Bushmen and the natives of Australia.

The storage of vegetable food.—Vegetable food being much more easily stored than animal, it is not surprising that the pre-cibiculturists should store the former more commonly than the latter, though in this respect they are surprisingly improvident.

Vegetable foods consumed in the raw state.—Pre-cibicultural peoples consume their vegetable food both raw and cooked, but as might be expected, a larger proportion of it is eaten raw by them than by the cibiculturists. We moderns cook *all* our vegetable foods except the luscious fruits, nuts, and those which are eaten under the name of salads, the latter being generally taken with vinegar, which helps in digesting them. On the other hand, pre-cibicultural man consumes a large quantity of vegetable food in the raw state, not only the luscious fruits, nuts, and green foods, seaweeds, and mushrooms being eaten uncooked, but also a considerable number of seeds and roots, the latter fact suggesting that before man began to cook he already grubbed up roots to eat—just as we know baboons to do.

It is an interesting fact that the pre-cibiculturists sometimes put their vegetable food through processes of preparation other than cooking, notably crushing and maceration, the food thus prepared being eaten in the raw state. This strongly supports the conclusion already suggested that even before the invention of cookery man had begun to submit his vegetable food to artificial processes. To this day the Highland gillie is content to eat his oatmeal, mixed with a little water, in the raw state.

The preparation of vegetable food.—The pre-cibiculturists display, in the search and preparation of their vegetable food, a knowledge, resourcefulness, and ingenuity which cannot but excite our admiration. Sheer necessity has made them good practical botanists, well versed in the nature and characteristics of every species of plant likely to serve them as food, and their ingenuity has taught them to prepare these natural products in a variety of ways. They know how to harvest and hull the wild cereals, how to dry and to grind various seeds and roots and to make of the flour biscuits, cakes, and puddings, and—most remarkable of all—how from a number of disagreeable and even deadly vegetable substances to prepare wholesome and palatable foods. The latter feat they chiefly accomplish by maceration and the application of heat.

As with the ingathering of the vegetable food, so, too, its preparation falls to the lot of the women: they it is who pull the grain, grind the seeds and roots, free them from acrid and poisonous matters, and undertake all the complex details of cooking. Cooking is, indeed, with them no light task, in proof of which it is only necessary to refer to the fact that roots are often cooked in rush baskets which rarely serve for more than two cookings.

Sometimes vegetable foods are buried underground, and allowed to remain there until they have undergone partial decomposition, when they are dug up and consumed.

Starch- and sugar-extraction unknown to the pre-cibiculturists.—It is somewhat remarkable that in spite of the elaborate processes through which certain of the pre-cibiculturists put their vegetable foods, in spite also of the fact that many of these foods are rich in starch and sugar, no pre-cibicultural people has learnt how to extract these substances. This is probably to be explained by the want of vessels suitable for holding water and resisting fire.

Honey.—No account of the food of the pre-cibiculturists would be complete without a reference to honey, which constitutes an important source of nutriment for all of them, Esquimaux and Fuegians only excepted. The quantity of honey obtained is often considerable. The Australian natives carry away in baskets specially made for the purpose what they cannot eat on the spot, and so large is the quantity which the Andamanese obtain that they realize a respectable sum annually by selling it to the residents at Port Blair: they store it in bottles and barrels and are generally able to provide a continuous supply throughout the year. A common way of eating honey with the Australians is to smear a piece of porous bark with it. The honey then becomes partially absorbed, and the primitive sweetmeat is handed round, to be eagerly sucked and chewed by all the company in turn; when sucked dry it is again replenished with honey and again sent round.

Drinks

Water.—The drink of the pre-cibiculturists consists of water obtained from pool, lake, spring, or stream. Though the

Australians are known to dig wells down to a depth of eight feet, primitive tribes rarely resort to this method, partly because with their rudimentary implements it entails great labour, but chiefly because they seldom remain for any length of time in one place, and wandering about, select spots for encampment where water can readily be procured. In regions where water is scarce the Australian is sometimes able to slake his thirst by piercing the bark of certain succulent trees and tapping them for their watery sap.

Inasmuch as the pre-cibiculturists are continually on the move and do not congregate in large numbers, the water they drink is probably but seldom tainted with sewage, and they consequently rarely, if ever, suffer from such water-borne diseases as enteric and cholera.

Pre-cibicultural man generally drinks by bending down to the water's edge and applying his mouth directly to the liquid, in this resembling the anthropoid ape; or he may use his hands as a cup, a method never employed by the apes, though they sometimes adopt the expedient of immersing one hand in the water and then licking off the liquid. Mr. Hillier informs us that certain Australian tribes employ a mode of drinking which may be described as "hand lapping," the water being shot by one hand with remarkable accuracy into the mouth, which is held from twelve to eighteen inches above the pool, the hand travelling to within about six inches of the mouth. Drinking vessels, such as shells, are only occasionally used. It would therefore seem that primitive man seldom, if ever, drinks with his meals, in this respect resembling the lower animals.

Therapeutics of water.—The pre-cibiculturists are not wholly ignorant of the therapeutic uses of water. The Australians imbibe large quantities for the cure of dyspepsia and sometimes prescribe the cold bath; the Fuegians, when ill, drink freely of it in order to promote perspiration, while the Northern Californians employ it for the cure of a variety of maladies in that primitive form of Turkish bath to which the Franciscan Fathers gave the name of "temescal."

Artificial drinks.—Although the drink of the pre-cibiculturists is mainly confined to water, they do occasionally make artificial drinks. The Australians prepare a beverage by dissolving "manna" and gum acacia in water, manna being a sweet substance which exudes from the leaves of certain gum trees. The Californians soak crushed manzanita berries in water and imbibe the liquor by means of "the shaggy knob of a deer's tail," which thus does duty as a spoon. Doubtless they make other similar drinks.

Ignorance of alcohol.—The pre-cibiculturists are wholly ignorant of the art of making alcohol. That discovery belongs to the agricultural period.

5. THE CIBICULTURAL PERIOD

The cibicultural epoch began, we may conjecture, some 30,000 years ago. One of the first advances in the direction of vegetable food culture was the storage of supplies to provide against seasons of dearth; a second was the protection of plants valuable as food, both of which agricultural foreshadowings are to be observed among the Australian pre-agriculturists. In the same way man had learnt to preserve and to store animal food long before he began to breed animals. Whether he cultivated plants or bred animals first we need not discuss, but it is certain that, in the New World at least, plants were first cultivated. In any case a great forward step was taken when man began to produce food artificially, when, instead of having to search laboriously for fruits, roots, and seeds, he took to cultivating them ready to his hand, and when, in place of spending long hours in the hunt which at best could yield but a very limited supply of animal food, he learnt to raise on his own account flocks and herds of oxen, sheep, goats, and pigs, and to breed birds of many varieties; and when, again, he increased his supply of fish by building fleets of fishing vessels.

The total effect of food culture has been to make man more vegetarian than carnivorous, inasmuch as it has increased the supply of vegetable more than that of animal food—a given acreage of land yielding far more of the former than the latter.

So far as agriculture is concerned the epoch under consideration falls into two sub-periods:

(*a*) The period of migratory agriculture, in which limited patches of virgin soil were planted, after little or no preparation, and abandoned for new ones when the harvest had been reaped. During this period man still remained a hunter, combining hunting and fishing with the desultory agriculture, and he still subsisted largely on the products of the uncultivated vegetable kingdom, some of which he cooked while others he ate raw.

(*b*) The period of stationary agriculture—our own—when the ground is carefully tilled, manured, rolled, and, if necessary, irrigated. At the beginning of this period man continued to obtain a certain proportion of his animal food from the chase, but most of it was derived from the animals he had domesticated and from fishing; similarly, while his vegetable food was obtained chiefly by cultivation, he still continued to use a small proportion of uncultivated vegetable food, eating it both raw and cooked. Even in Europe several species of wild plants and fruits are to this day gathered for food.

It is important to distinguish between the period of migratory and the period of fixed agriculture, for so long as the human community was wandering and occupied almost entirely with the food quest, substantial progress in any direction was barred. It was only when agriculture had become stationary—say some 15,000 years ago—and an abundance of highly nutritious vegetable food and, in some cases, of artificially reared animal food also, had been secured by the labour of a limited section of the community, it was only when in this way a large amount of the total sum of human energy was liberated and made available for other purposes than the food quest, that that complex division of labour which is essential to social progress became possible.

Now we have seen that cookery led the way to agriculture, and it may therefore fairly be claimed for it that it opened the road to all the subsequent great discoveries of man and may thus be regarded as one of his greatest.

It seems probable that man first cultivated fruits, next roots, and finally the cereals, the latter requiring more careful tilling of the soil than either fruit-trees or roots. The cereals are much the most important of the three classes, owing to the large amount of protein they yield and the readiness with which they can be stored. Thus their cultivation paved the way for civilization. Payne indeed holds that without it civilization would have been impossible, but he perhaps underestimates the fact that there are other highly nutritious and easily stored vegetable foods, among which the pulses occupy a prominent place.

Of the luscious fruits the most nutritious are the banana—which contains a goodly proportion of protein—the grape, the fig, and the date, all of which have been improved from their wild congeners almost beyond recognition. The food value of the cereals and the roots has been similarly augmented.

We have seen how the quantity of starch available for food increased with the introduction of cookery; it has been, of course, still further increased by means of agriculture, and starch is at the present time actually extracted and consumed in the pure state. Similarly with the supply of soluble saccharides—grape sugar, fruit sugar, and cane sugar. Before the agricultural period these were only available in comparatively small quantities which were derived mainly from the luscious fruits and from honey. With the progress of agriculture, however, and the cultivation of the date, fig, and banana, and in later times of the sugar cane and beetroot (from both of which cane sugar is now extracted in enormous quantities), the supply of soluble saccharide has reached astounding proportions.

From the beginning of the agricultural period there has been a progressive abandonment of raw vegetable food, the power of digesting which, after steadily waning during the previous diet epochs, has consequently still further declined.

Very few uncultivated vegetable foods are now eaten raw, and with the exception of the fruits very few of the cultivated varieties either. The tendency moreover is to prepare vegetable foods in forms exciting to less and less mastication. Vegetable food when boiled can be swallowed after less mastication than when baked, and when finely ground than when coarsely ground. Thus boiled suet pudding does not get so much chewing as unleavened bread made from coarse flour.

Nevertheless, some soft vegetable foods tend to excite mastication. Thus the mealies of the South African, and to a less extent the boiled rice of the Hindu, are so prepared as to give rise to considerable mastication ; on the other hand, certain kinds of bread and biscuits excite very little. If we glance at the vegetable food of the English people at the present time we shall find that hardly any calls for mastication. Boiled vegetables are all soft, and most of our farinaceous food takes a liquid, pappy, pultaceous, or spongy form, such as potatoes (often mashed), bread (mostly new and with little well-baked crust), bread and milk, rusks soaked in milk, porridge, gruel, milk puddings (rice, tapioca, vermicelli, sago), other puddings (butter, suet, plum), cakes (caraway seed, currant), scones, buns, muffins, crumpets, pastry, (in forms too numerous to mention), macaroni, blanc-mange, biscuits. Of all these only bread-crusts and biscuits tend to excite mastication, and they very insufficiently, for the crusts are often soft and not rarely avoided, and the biscuits are generally of a kind that readily crumbles between the teeth. The rest slide down into the stomach with pernicious ease, and afford little or no exercise for jaws or salivary glands. From the point of view of dietetics the present age may, in this country at least, be characterized as the "Age of Pap."

The general effect of agriculture upon man's diet has therefore been to accentuate the effects already noticed as following on the invention of cookery. There has been a further increase in the amount of starchy foods and, owing to diminished mastication and insalivation, an increase also in the amount of crude starch entering the stomach.

Concentration of diet.—We have seen the diet of the evolving man becoming epoch after epoch more and more concentrated. At the present time this process has reached its acme, so that a high degree of concentration is perhaps the most characteristic feature of the neo-man's diet.

How very condensed modern diet is does not seem to be adequately realized. Writers on treatment are constantly recommending a "highly nutritious diet," and the energy values of various foods are carefully estimated with a view to indicating their several nutritive values. Yet, as a matter of fact, it is no easy matter to prescribe an innutritious diet, unless it be one consisting of green vegetables or luscious fruits. That all kinds of animal food—milk, eggs, fish, game, and "meat"—are highly nutritious needs no insistence. The like is true of our most important source of vegetable food, the cereals, which contain a high percentage of protein and starch. Moreover, man has learnt to separate all the energy-yielding food-stuffs—protein, fat, starch, and sugar—from their natural combinations, and much of our modern food consists of these substances in what is practically the pure form. Thus fat is separated from milk as butter, and fat and casein in the form of cheese. Large quantities of starch, again, are extracted from vegetable substances, yielding such highly nutritious food as sago and tapioca, while enormous quantities of pure sugar are obtained from sugar-cane and beet-root, to say nothing of the large supply of vegetable fat and protein now placed on the market.

This extreme concentration of modern diet has three consequences: (*a*) It is chiefly responsible for the present prevalence of constipation, a prevalence so great that man has actually been defined as "the constipated animal." (*b*) It promotes over-eating: a concentrated diet—especially when at the same time it is soft, as so much modern vegetable food is, and thus slips easily into the stomach—is apt to be consumed in excess before the sense of satiety is produced. (It does not seem unlikely that a type of person is being evolved capable of coping with an excess of food.) (*c*) It is rendering some extent of the alimentary tube, notably of the larger bowel, redundant.

The artificial rearing of children.—Another striking feature of the cibicultural age is the practice of bringing children up by hand. Among the pre-cibiculturists no infant can survive unless the mother can suckle it. Indeed, recognizing that if the mother dies during child-birth or if she cannot suckle her infant, it cannot be reared, they deliberately destroy it. Thus it came about that prior to cibiculture all mothers with defective nursing capacity were racially eliminated, i.e. prevented from leaving offspring who might inherit their defect, just as were those who were deficient in maternal instinct—in the love of, and willingness to sacrifice themselves for, their offspring. For this reason the mammary function and the maternal instinct were, and still are, kept at a high level of efficiency among the pre-cibiculturists. The like is true of the early agriculturists. Not until man learned to obtain the milk of certain animals he had domesticated, such as the goat, the mare, and above all the cow, was it possible for mothers defective in nursing capacity to rear their offspring; but these defective types being no longer racially eliminated, or at least not to the same extent as before, there has necessarily been taking place a lowering in the racial standard of mammary function. Similarly, when in the course of social evolution many mothers were able to relegate the care of their offspring to hirelings, it became easier for mothers defective in respect of the maternal instinct to leave behind them offspring all tending to inherit the like deficiency. It is not therefore surprising that in many respects the neo-woman should be maternally less well equipped than her primitive ancestors.

We may observe the same kind of process at work among domesticated animals. Their breeding instincts are found to have been warped by man's interference. For instance, under natural conditions only those hens which are good sitters could rear a brood of chickens, but man places the eggs of the bad sitters under good sitters, or he artificially incubates them in a "foster mother," and the bad sitters being thus enabled to have offspring, this type is becoming more and more common. The like is true of the artificially reared pheasant, which now rarely lays its complement of eggs in a single nest, but generally deposits them in several separate places.

Much as we may regret the fact, one can hardly doubt that women, whether from maternal incapacity or disinclination, will tend more and more to bring up their children by hand, and that the mammary function will in consequence undergo a progressive atrophy. Side by side with this maternal devolution we may look for a corresponding evolution to take place, by natural selection, in the digestive organs of the young human. Seeing that cow's milk has come to be the chief food on which artificially fed infants are reared, we may expect the infant's stomach to evolve the power of digesting this particular milk, and one cannot but wonder whether some enterprising person may not one day attempt the task of breeding an animal of which the milk shall approximate in composition to human milk, so that the two evolutions, digestive in the infant and mammary in the animal, shall proceed towards the same point and eventually meet.

Artificial drinks.—On this subject it must suffice to observe that whereas the drink of pre-cibicultural man is almost entirely confined to natural water, neo-man relies almost entirely on artificially prepared beverages.

SUMMARY OF THE CHANGES WHICH HAVE TAKEN PLACE IN THE DIET OF THE EVOLVING MAN

We may now rapidly review the chief changes which have taken place in man's diet during the successive phases of his evolution.

1. **Relative quantities of animal and vegetable food.**—Our ancestors were mainly vegetarian during the simian and homosimian stages, but with increasing intelligence they naturally became able to obtain more and more of the much coveted animal food, such as insects, grubs, eggs, and the smaller game, and there took place in consequence a steady rise in carnivorism during these stages (*see* Fig. 3). With the advent of the early hunting period, and the ability to secure larger game and a considerable quantity of fish, man soon became actually more carnivorous than vegetarian. Then cookery, by increasing the supply of vegetable food, set the tide in the opposite direction, and by the end of the early cookery period man was about equally carnivorous and vegetarian. Thenceforward, with the development of agriculture, he became more and more vegetarian.

2. **Increased concentration of vegetable food.**—Vegetable food has become increasingly concentrated since the simian era (*see* Fig. 4). As the evolving man grew in intelligence he became more and more dainty in his choice, discarding the coarser and more bulky kinds in favour of the more concentrated. This was the easier seeing that with his increasing carnivorism he became correspondingly more inde-

pendent of vegetable food. The introduction of cookery tended in the same direction. It was not, however, until the agricultural period that his vegetable food reached a high degree of concentration. To attain this has, indeed, been the

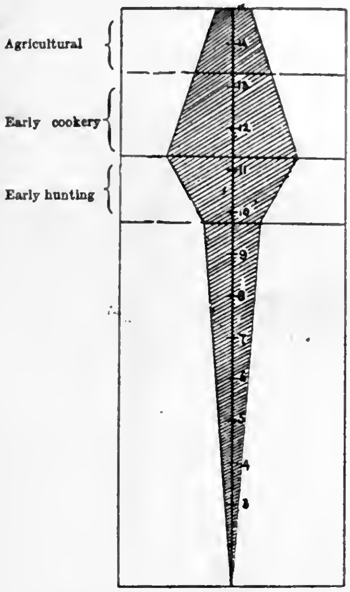

FIG. 3.—Diagram showing the Relative Quantities of Animal and Vegetable Food Consumed during the Various Phases of Man's Evolution.

The unshaded area indicates the quantity of vegetable food ; the shaded area that of animal food.

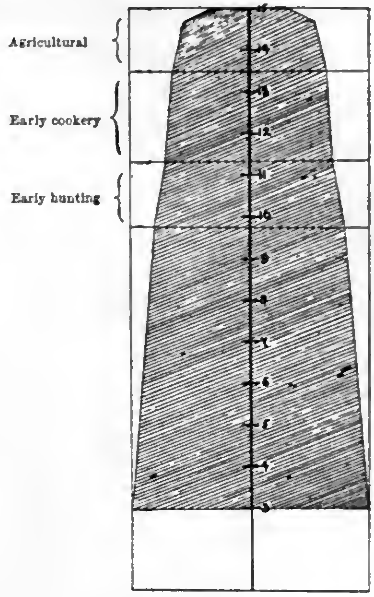

FIG. 4.—Diagram showing the Increasing Concentration (i.e. diminution in bulkiness as represented by the shaded area) of Vegetable Food from the Simian Era onwards.

chief object of agriculture. At the present time, when all the food-stuffs—starch, sugar, fat, etc.—are extracted in their pure state from vegetable substances, the process of concentration has probably reached its limit.

3. **Change in the consistence of vegetable food.**—Just as the vegetable food of man has become more and more concentrated, so also has it become progressively softer. Before the adoption of cookery these two changes progressed at equal rate, but from the first employment of that process right up to the present time there has been a progressive abandonment of raw in favour of the softer cooked vegetable food (*see* Fig. 5). Agriculture,

by diminishing the quantity of cellulose in vegetable food, has operated in the same direction. In this present neo-agricultural age the softness of our vegetable food has assuredly reached its limit, for in the first place only a small quantity of raw vegetable food is consumed, and that almost wholly of the comparatively soft cultivated kind, and in the second place the cooked vegetable food is for the most part soft.

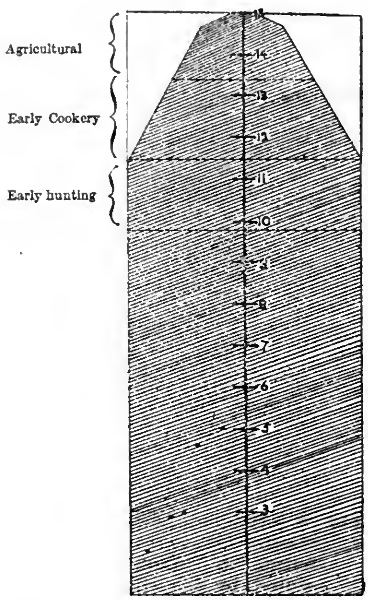

Fig. 5.—Diagram showing the Relative Quantities of Raw and Cooked Vegetable Food consumed during the Various Phases of Man's Evolution.

The shaded area indicates the quantity of raw vegetable food consumed; the unshaded area that of cooked vegetable food.

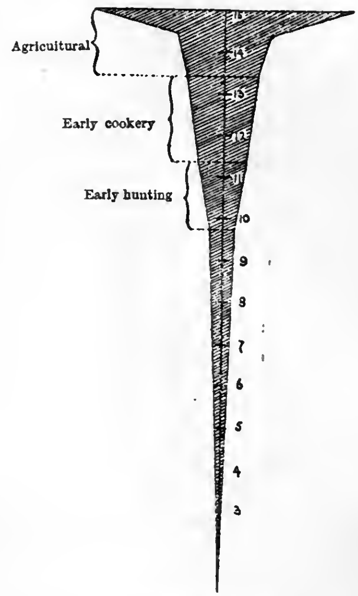

Fig. 6.—Diagram showing the Increase in the Quantity of Sugar consumed during the Various Phases of Man's Evolution.

No attempt is here made to indicate the proportion of sugar to other foodstuffs consumed.

There can be little doubt that dental caries and pyorrhea alveolaris were practically unknown in pre-cookery times. They have increased in direct proportion with the softness of the vegetable food.

4. **Increased consumption of sugar.**—The quantity of sugar consumed has undergone a steady increase from simian times (*see* Fig. 6). Prior to the agricultural period sugar was derived from honey, the luscious fruits, and to a less extent from

other vegetable substances. As the evolving human grew in intelligence we may assume that he secured an ever-increasing supply of luscious fruits, but it was not until he learnt to gather wild honey that he was able to obtain sugar in the pure form. When he first did this we cannot say, but it is not likely that he obtained honey in any quantity until the early hunting period, for the gathering of it demands considerable ingenuity. That he was able to obtain quite large quantities in the early cookery period is evident from our knowledge of extant pre-agriculturists.

With the development of agriculture and the cultivation of such highly saccharine fruits as the date, the fig, the grape, and the banana, man's supply of sugar underwent rapid augmentation, and when he learnt to extract it from the sugar-cane and the beetroot the supply went up by leaps and bounds. At the present time thousands of tons of sugar are annually extracted. In our own country its consumption has within recent years increased enormously.

INFLUENCE ON FUNCTION AND STRUCTURE OF THE SUCCESSIVE CHANGES IN THE DIET OF THE EVOLVING MAN

The dietetic changes which we have been considering have been met by corresponding changes in function and structure.

Function.—The ability to digest animal food rose and fell with the quantity consumed during the various diet epochs, and was thus greatest during the early hunting period. The Esquimaux may be regarded as being still in this stage, and doubtless their capacity to digest large quantities of animal food greatly exceeds that of the average man.

The ability to digest vegetable foods in the raw state, especially the coarser kinds, has steadily diminished from the simian stage until the present time. One can scarcely doubt that our simian ancestors had special powers of coping with cellulose, as well as with the bitter and acrid constituents met with in many vegetable foods.

Since before the discovery of cookery most of the vegetable food was subjected to prolonged mastication and in consequence intimately mixed with saliva, we may presume that in pre-cookery times salivary digestion was correspondingly active, and that the amylitic power of the salivary glands was greater than it is in the neo-man who, owing to its softness, masticates his vegetable food very little. We must suppose that during the entire cookery period there has been a waning of the function of mastication.

Seeing, moreover, that up to this period very little crude starch entered the stomach, we may assume that in pre-cookery times the digestive organs were intolerant of large quantities of starch, but that after the introduction of cookery their ability to deal with it steadily increased, becoming ultimately greatest in those communities which, like the Hindus, subsist mainly on vegetable food.

The recent large increase in the consumption of sugar is probably leading to a similar increase in the power to digest sugar.

These adaptations have taken place by natural selection, e.g. by the survival of certain types, a process which, indeed, we may see going on under our very eyes. Tens of thousands of starch-deluged and bottle-fed children are in our own country yearly weeded out, those best adapted to this mode of feeding surviving and handing down their peculiar digestive traits to their offspring.

The adaptations referred to are congenital and racial, but in considering man's digestive capacity we must not lose sight of his extraordinary personal adaptability to different kinds of food, a characteristic which has doubtless been acquired in the struggle for existence, and has given him considerable advantage over other animals in that struggle.

Of all animals the frugivorous mixed feeders exhibit the greatest adaptability to different kinds of diet. The herbivora have difficulty in digesting any food other than vegetable, while the carnivora experience a similar difficulty in digesting (in the raw state at least) any but animal food; among the mixed frugivorous feeders, on the other hand, the range of digestive capacity is considerable, being widest in that most omnivorous of mixed feeders, man, and it is largely on this account that he has been able to range far and wide over the earth, and adapt himself to the different kinds of food afforded by different regions. Thus some, like the Esquimaux, have come to be almost pure animal feeders, and others, like the high caste Hindus, to be pure vegetarians.

That man quite early in his philogenesis acquired great digestive adaptability is suggested by the fact that the anthropoid apes can be made to subsist on a diet very like that of neo-man, though doubtless man's capability in this respect has considerably increased since simian times.

This readiness of adaptation needs to be constantly borne in mind, for it shows that there is no fixed stereotyped dietary normal to man, as there is in the case of animals like the herbivora and the carnivora, but that he is capable of adapting himself to many and widely varying systems of diet, as is well attested by the very different dietetic customs prevailing in different countries.

Nor must it be forgotten that individuals differ greatly in their digestive idiosyncrasies. We meet with some, e.g. who exhibit a natural tendency to vegetarianism and a dislike of animal food, and others who, though not objecting to animal food, have some difficulty in coping with any but small quantities, especially when in the form of "meat." Such persons, arguing from themselves, are too apt to assume that man is by nature vegetarian and to decry all animal food as poisonous to him, the real truth probably being that their vegetarian leanings are atavistic in character—survivals from a far-off frugivorous past.

Structure.—Though the functional changes which have taken place in the digestive system of the evolving man have necessarily a structural basis, those changes are, as far as they can be detected, far less marked than might perhaps be expected. There is a notable general resemblance between the digestive organs of man and of the great apes, a fact which shows that these organs in man have undergone very little visible change since simian times. One of their most striking anatomical differences is in the valvulæ conniventes, which in the apes are rudimentary only. Another pronounced difference is the greater muscularity of the simian stomach, a character which fits it to cope with the coarse varieties of vegetable tissue which enter so largely into the food of the apes.

We are, unfortunately, not able to state minutely in what respects the digestive organs of existing pre-cibiculturists differ anatomically from those of the neo-man. It is probable that the digestive tube is larger and more muscular in the former case.

The dental formula of the apes is the same as for man, though the teeth of the former are larger and stronger than those of the latter, and therefore adapted for coarser and more vigorous work. Since man, before he learnt to break up the cellulose framework of his vegetable food by cooking, grinding, and other means, was compelled to make vigorous use of his maxillary apparatus, we may be sure that in the pre-cookery period his jaws and teeth were correspondingly strong and massive, but when, with the discovery of artificial means of disintegrating the cellulose, mastication was in great measure relieved of one of its chief functions, they began to get smaller, while dental caries, hitherto almost unknown, became less rare, invading chiefly the third molars ("wisdom" teeth). Again, as the effect of agriculture was to reduce the cellulose constituents of vegetable food and thus to render it more easy of mastication, we find the jaws and teeth further diminishing in size during the agricultural period and diseases of the teeth increasing in frequency. These effects were not, however, pronounced during the early agricultural epoch, partly because man still continued to eat freely of raw vegetable food, and partly also because much of his cooked vegetable food needed, owing to its coarseness, considerable mastication. It is not until we arrive at the neo-agricultural stage that the effect upon jaws and teeth of food artificially produced and prepared becomes pronounced. In consequence of the softness of modern food the jaw does not grow to its normal size, with the result that the teeth, whose growth is not affected to the same extent, are often unable to take up their normal positions. For these and other reasons associated with the softness of the modern vegetable dietary dental diseases have assumed alarming proportions.

The Seasonal Rotation of Food

A minor point, but one which should not be overlooked, is that change of season once had, and on the diet of the pre-cibiculturists still has, a much greater influence than on our own to-day. The food of the former varies from month to month, nay, even from week to week. Thus we find the Californians in the early part of the year eating the bark of trees, then clover, next roots, and about the middle of summer, salmon; after that various kinds of seeds come into season, then manzanita berries and pinon nuts, and finally acorns, while game and vermin of various kinds are consumed throughout the year. There is no such pronounced seasonal rotation of food among communities living in the modern cibicultural age. With the manifold facilities at our disposal for artificially producing, storing, and rapidly conveying food from place to place, we moderns are able to subsist upon much the same kind of food throughout the year. Butcher's meat, birds, fish, bread, rice, milk, cheese, butter, eggs, sugar, and some vegetables—e.g. potatoes—are available at all seasons. It is only in respect of highly perishable vegetable foods, such as green vegetables and certain fruits, that the influence of season makes itself decidedly felt, and this influence is every year becoming less and less, as new methods of storage are devised and more rapid means of transit provided.

CONCLUSIONS

We can now summarize some of the more important practical truths which the study of man's dietetic past teaches us.

1. The fact that man has evolved from the ape on a highly carnivorous diet at once disposes of the contention so constantly put forward by the unreflecting, that he is essentially vegetarian *by nature*, and that "meat" and other animal foods are necessarily harmful to him. Doubtless there are some who cannot tolerate meat, and to whom a diet largely, if not entirely, vegetarian is the most suited, but such persons are exceptional, and it may be added subnormal, in respect of digestion and metabolism. "Meat" and other kinds of animal food are often

credited with being the cause of ill-health when the saccharide constituents of the diet are equally, if not more, responsible, for in many cases in which improved health follows upon the curtailment of animal food an equally good, perhaps even a better, result could be obtained by cutting down the saccharides. Again, it is often contended that centenarians owe their great age in large measure to the fact of their having always eaten sparingly of meat, whereas it will generally be found that they have been just as moderate in regard to the other items of their food—indeed, that they have observed moderation in most things.

2. The fact that right up to the beginning of the agricultural period man's supply of sugar was scanty, whereas during it and especially within recent times, it has been enormously increased, suggests that ill-health may often result from its excessive consumption. Experience proves this to be the case; we are often able to effect great improvement in health simply by reducing the intake of sugar.

3. Since in pre-cookery times practically all the starchy food had to be laboriously masticated in order to break up the non-digestible cellulose portion, any starch ingested underwent thorough insalivation, with the result that it was to a large extent digested in the mouth and only a small quantity entered the stomach in the crude form. At the present time, owing to the combined influences we have seen at work, not only is the proportion of starch in vegetable food much higher than it used to be—some foods consisting, indeed, of practically pure starch—but this substance is for the most part consumed in a form so soft that it slips into the stomach without having undergone any buccal digestion whatever. As a result the stomach is apt to be burdened with an excess of crude starch leading to disturbance of digestion, disorder of the blood, and impairment of nutrition.

4. The facts that within recent times the supply of vegetable food has increased more than that of animal food, that the softness of modern vegetable food favours its excessive consumption, and that enormous quantities of pure sugar are accessible, prepare us for the conclusion that the neo-man is more likely to suffer from an excess of highly saccharide vegetable food than from an excess of animal food. As a matter of experience we can, on

the whole, do more good by curtailing saccharides than by cutting down animal food, and this even in such diseases as gout and megrim.

5. Animal and vegetable food stand in sharp contrast as regards the need of mastication. In the raw state the former does not require any mastication while the latter needs a great deal. The carnivora do not masticate their food; their teeth are adapted to tear flesh and crush bone, and are prevented by their shape from executing the lateral movements necessary to mastication. On the other hand, all the herbivora masticate their food laboriously, with the object, there can be no doubt, of breaking up its cellulose constituents. In the case of the ruminants food which has been swallowed is actually regurgitated for the purpose of being re-chewed at leisure, so essential in their case is efficient mastication to proper digestion.

Again, the effects of cookery on animal and on vegetable food are opposite as regards the need of mastication. By coagulating the albumen of animal tissue cooking may so harden it as to make mastication necessary; whereas by rupturing the non-digestible cellulose compartments of vegetable food (and thus liberating the contained starch, etc.), and also by its softening influence, cooking largely does away with the mechanical need of mastication. Hence cooked vegetable foods, especially the softer varieties, can be, and often are, swallowed without any more than a pretence at mastication, with the result that the jaws are not properly exercised nor the starch properly insalivated. We should therefore insist that some at least of the vegetable food, especially during the years of development, should be taken in forms which compel adequate mastication, such as stale bread, bread-crusts, and hard biscuits. Only in this way will opportunity be afforded for the normal masticatory instinct to develop, an instinct too often stifled at its birth by the prevalent system of pap-feeding.

6. The fact that during the entire period of his evolution from the simian man's vegetable food was eaten raw, whereas at the present time almost the whole of it is cooked, suggests that good may often result from increasing the proportion of raw vegetable

food, such as apples, bananas, nuts, and salads, all of which should be thoroughly masticated.

7. The fact also that our vegetable food is so very much more concentrated now than it was in the time of our ancestors suggests the advisability of including a due proportion of bulky vegetable foods in our dietary.

8. The food of primitive man was simple, consisting of animal and vegetable tissues in their natural state; in other words, it was not subjected to elaborate processes solely for the purpose of pleasing the palate. Though it is not desirable on this point, any more than on any other, to aim at a *rigid* simplicity, yet the ideal dietary is in the main a simple one.

9. Before the period of fixed agriculture the quantity of food was not in excess of physiological requirements, for though primitive man doubtless had his bouts of gourmandizing, he also had his intervals of enforced starvation; moreover the constant food quest entailed an active mode of life which rendered chronic over-eating impossible. There might be abundance of game, but it had to be hunted; the rivers might teem with fish, but the fish had to be caught; seeds and roots might be plentiful, but they had to be gathered. Hence, though in seasons of plenty primitive man may have grown plump, obesity was practically unknown. These considerations suggest that though man is none the worse, and may, indeed, be all the better, for occasional dietetic indulgence, strict moderation in eating is the ideal to be aimed at.

10. The fact that man is descended from an ancestry whose diet has for long ages varied considerably throughout the year in all temperate latitudes, helps to explain the evil effects of monotony in diet, and emphasizes the importance of introducing variety into it.

11. It is evident from a study of his dietetic past that the digestive system of man is highly adaptable, and that consequently his dietary is not stereotyped as it is for the most part in the case of the lower animals, but is capable of being modified to an almost unlimited extent.

To put briefly the chief lessons to be learnt from man's dietetic history: The ideal dietary should be simple in quality and moderate in quantity. It should contain a certain proportion, say from a quarter to a third, of animal food. Animal food requires little chewing; most raw vegetable food, and all cooked starchy foods require a great deal. Hence it is advisable to give most of the starchy foods in a form compelling vigorous mastication, and a certain proportion of vegetable food should be consumed uncooked. Care should be taken to guard against an excess of sugar. The diet should not be monotonous. Water should be the staple drink and should not be taken with food.

But while these are safe general rules it must not be forgotten that marked dietetic idiosyncrasies are met with, and that men individually display considerable adaptability as regards different kinds of food. Hence it is not possible to attempt the construction of a stereotyped dietary for man, nor if it were would it be advisable, since his dietetic adaptability is an advantage to the race.

THE PHYSIOLOGY OF DIGESTION, ABSORPTION, AND NUTRITION

CHAPTER III

THE PHYSIOLOGY OF DIGESTION, ABSORPTION, AND NUTRITION

By E. I. Spriggs, M.D., F.R.C.P.

The energy needed for the various activities of the body is furnished by the processes of oxidation which take place in every living cell. The oxygen used is obtained from the atmosphere. The chemical substances oxidized are derived from materials taken into the body, which we call food. The constituents of the food are, however, seldom in a suitable condition for absorption into the blood, and before this can be effected they undergo a series of chemical and physical changes known as **digestion.** The products of digestion are then taken up by cells lining the alimentary canal, and passed into the blood in the process of **absorption:** this is not a simple transference of a given substance across the alimentary mucous membrane, but itself includes chemical change. Further, the materials absorbed from the intestines into the circulating blood are not even then in a form entirely suitable for oxidation in a cell, but have to suffer later transformations which are comprised in the term **assimilation.** The molecules finally presented to the living protoplasm may be oxidized rapidly for the sake of the energy thus set free, or may be built up for a longer period of time into the tissues of the cell.

The term **metabolism** is used to designate all the chemical processes occurring in the tissues of the body; it includes building up, assimilative, or anabolic processes, and breaking down, or katabolic processes, whether they take place in the essential protoplasmic structure or in the tissue fluids which bathe the cells.

Since the body is continually oxidizing its own substance, the materials supplied to the cells must, besides being capable of oxidation, contain the elements necessary to replace the tissues as they are broken down. The degree to which a cell uses its own substance will vary with the needs of the body and the supplies of new material. If nutrition is adequate and the calls made upon the cell not excessive, the cell will be able to furnish energy from the oxidizable substances available, and the demand upon its own tissue will be minimal. In starvation, on the other hand, the body is obliged to fall back upon its own substance, using the less essential tissues first. The food has thus to fulfil two functions, first, to supply the necessary elements for the structure of the body, and secondly, to furnish energy for the activities of the body. We may refer to these by speaking of the **metabolism of structure** and the **metabolism of function**.

In the study of dietetics it is of great importance that these two purposes to which food may be put should be clearly borne in mind.

The **metabolism of structure** includes the building up of the tissues and organs, the replacement of such portions of them as are continually being disintegrated, and the transformations which these portions undergo before they are excreted. Both inorganic and organic substances are required for this purpose ; the inorganic, such as mineral salts and water, furnish no energy, but are as essential to the maintenance of the structure of the body as the organic proteins which are built up into living protoplasm.

The **metabolism of function** is concerned with the furnishing of energy for the performance of the normal functions of the various organs. For this, one or more of the organic food-stuffs, protein, carbo-hydrate, or fat is necessary.

Protein can therefore play two parts : it is essential to the structure of the body because the animal can obtain the nitrogenous materials necessary to form protoplasm from no other source ; and, on the other hand, when it is not needed for the growth or repair of tissue it can be oxidized and set energy free.

DIGESTION

The term **digestion** is applied to all those processes by which the food substances are converted into a convenient form for absorption. Digestion is carried on in the alimentary canal. This, regarded simply, is a hollow muscular tube richly supplied with blood vessels, having its mucous surface bathed with juices yielded by glands, and lined by epithelium from which these glands are developed and which along a great part of its length is possessed of the special property of absorbing nutritive matter. The food is exposed to the digestive juices at particular regions in its passage along the muscular tube, and the chemical changes which it undergoes are brought about by the action of ferments contained in these juices. The structure of the alimentary canal as well as the ferments provided in the secretions differ in various animals according to the nature of the food. A diversity of structure is shown at the very commencement of the digestive tube by the **teeth.** Carnivorous animals have long canines for securing and tearing their food. The herbivora are provided with more molars, having a broad grinding surface suitable for the prolonged chewing which vegetable foods require to bring them to a semi-fluid consistence and to separate the fibre so that the digestive secretions may thoroughly permeate the mass. Animals feeding on insects have upper and lower incisors which accurately fit one another. In man the teeth are of the omnivorous type and are suited both for cutting and tearing and for grinding. The importance of the thorough mastication of the food is shown by the frequency with which indigestion follows when the food is eaten too rapidly or the teeth are lost.

The food, in the process of chewing, is brought into intimate relation with the **saliva,** produced from the parotid, sub-maxillary and sub-lingual glands and from numerous small glands in the mucous membrane of the mouth. The salivary glands are of especial historical interest, for their ducts were the first channels from pure secretory digestive glands to be discovered. That of the sub-maxillary gland was found by Wirsung in 1642, but its significance was first recognized by Wharton ten years later and described in a lecture before the Royal College of Physicians. The mixture of saliva from the different glands is an alkaline fluid containing ½–1 per cent of solids, consisting of mucin, a little protein and inorganic salts and a ferment ptyalin belonging to the class of amylases, which have the power of effecting the conversion of starch to sugar. The uses of saliva are mechanical and chemical. The solid food is mixed with it in mastication and made into a semi-fluid mass which can easily be swallowed. In the whale, whose food and pharynx do not need to be lubricated by a secretion, the salivary glands are rudimentary. The saliva, by keeping the mouth moist, is also a great aid to articulation.

The time which the food stays in the mouth is so short in man that the chemical action of the saliva cannot be at all complete, in spite of the fact that the action of ptyalin upon boiled starch is a rapid one. We shall see, however, that salivary digestion proceeds in the stomach for a considerable time after the food has been swallowed.

The secretion of saliva is brought about reflexly by food, and this before any of it is put into the mouth. The sight, the smell, and even the thought of food is sufficient to excite a flow, provided that the individual be hungry. Mechanical stimulation of the mucous membrane of the mouth has no effect, but food, and other substances with a strong taste, produce a copious secretion. Of the four primitive tastes, acids are the most effective, then salts, then bitters and then sugar. Pawlow has found in the dog that the nature of the saliva differs with that of the food—meat, for instance, calls forth a juice which is rich in mucin; the dog does not thoroughly masticate meat but simply lubricates it with this mucinous fluid and swallows it. If some dry material be put into the mouth, the saliva produced is watery and contains but little mucin. These differences are due to the fact that the different salivary glands produce different kinds of secretion, that from the sub-maxillary gland, containing much mucin, being poured out when meat is taken into the mouth, whilst when a plentiful supply of fluid is required to dilute some dry material, the watery secretion of the parotid gland is provided. Malloizel reports that the psychical flow of juice which follows the sight of food also varies with the nature of the food, a secretion rich in mucin being poured into the mouth of a hungry dog at the sight of meat.

The act of **deglutition** is begun by an ordered contraction of the muscles of the tongue, the soft palate and the pharynx, which surround the mass of food or of fluid and force it into the œsophagus. No other route is open, for the naso-pharynx and the larynx are both shut off by special muscular arrangements. The food is then grasped by the muscular wall of the gullet and passed down into the stomach. In the case of fluid the expulsion into the cardiac end of the stomach can be heard with the stethoscope over the lower dorsal spine, or the epigastrium, and by this means it was ascertained that the course down the œsophagus occupies about 6 seconds. This has been confirmed by watching the passage of a bismuth mixture with the X-rays, the average time between the commencement of swallowing and the expulsion into the stomach having been found by Hertz to be between 5 and 6 seconds, though there is considerable variation in this time both between different individuals, and in the same person. The transit is much quicker in the upper part of the œsophagus, the muscle of which is striated, and slower below where it is unstriated, about half the time being taken up in going through the cardiac orifice. Hertz found that a solid dry mass, such as a cachet of bismuth carbonate, was passed down very slowly indeed, unless well lubricated with saliva, and on one occasion took as long as 15 minutes to reach the cardia, the subject of the experiment being, however, under the impression that it had been successfully swallowed, and quite unconscious of its presence in the œsophagus. Such a delay does not take place with ordinary masticated food.

As soon as the food reaches the stomach digestion proper begins. In this process the food is first rendered soluble and secondly converted into a form suitable for absorption. It is not sufficient for the materials to be broken down and dissolved. They will not be absorbed by the intestinal walls unless certain definite compounds are formed. Thus, all the carbo-hydrates, such as starch, glycogen, dextrin, maltose, cane sugar, and milk sugar, must be hydrolyzed to monosaccharides, such as dextrose, levulose, and galactose. Fats are broken up into glycerine and fatty acids. Proteins are hydrolyzed to a large number of products belonging to the class of aminoacids.

These changes are effected by **ferments.** Proteins are attacked in the stomach by pepsin which hydrolyzes them to the hydrated proteins, albumoses and peptone. These substances would be broken down still further by pepsin but the passage of the chyme into the small intestine removes them from its influence and brings them under that of the powerful proteolytic ferment trypsin, which is more far reaching in its effects than pepsin, breaking down protein through albumoses and peptone into the aminoacids of which the molecule is built. A third ferment, erepsin, is contained in the succus entericus and aids in the disintegration of albumoses and peptone to aminoacids.

Starches are attacked by the ptyalin of the saliva with the formation of the polysaccharide dextrin and the disaccharide maltose. Very small quantities of dextrose are also formed. In the small intestine the carbo-hydrates are digested by the powerful amylase (amylopsin) of the pancreatic juice which forms maltose and a little dextrose. The succus entericus contains a maltase converting maltose to dextrose, an invertase converting cane sugar to dextrose and levulose, and a lactase converting lactose to dextrose and galactose.

Fats are split into fatty acids and glycerine by a lipase of weak action in the stomach and by a much stronger one, steapsin, in the small intestine.

The ferments are of the highest importance, for not only do they play the chief part in the chemical changes which food suffers in the digestive canal, but it is in all probability by similar agents that the nutritional processes of the body as a whole are carried on. We must, therefore, consider briefly their general properties. Ferments have not been separated in a pure form, and we know little of their structure. This is because the actual amount of the ferments present in any solution is extremely small and because they are very unstable ; even if a large quantity of a fluid having a strong ferment action be taken for analysis, by the time that the proteins and other bodies accompanying the ferment are removed a large part of it has been lost or destroyed. As far as has been ascertained ferments generally contain nitrogen, and it is probable that they are similar in structure to the bodies upon which they act. They are extremely sensitive to external influences, being easily destroyed by heat, and very susceptible to dilute acids and alkalies; pepsin, for instance, is only active in an acid medium and trypsin in an alkaline. All these ferments act by a process of hydrolysis, that is to say, the molecules upon which they exert their influence take up water and break down into simpler bodies. This method of disintegration is not in any way peculiar to ferment action. Weak acids or alkalies will cause hydrolysis of proteins and starches. At ordinary temperatures the change is small but it is much greater at boiling point. Boiling water alone will hydrolyze many substances, and even cold water does so, although very slowly. But the characteristic of ferment action is that the hydrolytic change is produced with great rapidity and at ordinary temperatures, each ferment having an optimum temperature which, in the cases we are discussing, is that of the body. This may be illustrated by the following experiments. The hydrolysis of a solution of muscle proteins in 4 per cent hydrochloric acid is accompanied in the early stages of the digestion by a fall in the viscosity of the solution which may be measured by the time taken by a given quantity of the fluid to flow through a capillary tube. In some observations of this kind the writer found that the change produced by pepsin in a few hours at body temperature was greater than that produced by hydrochloric acid alone in days at the same temperature or in months at ordinary temperatures. Substances which possess the property of hastening chemical reaction without being themselves affected are known as catalyzers. To this class the ferments belong. They act by rendering the transition from one molecule to another easy, and have been likened to a ladder by the help of which it is possible to get over a wall. The ladder does not supply any energy and can be used an indefinite number of times without suffering change, and the same is true in a general sense of the whole class of catalyzers. It is to be noticed that the ferments are specific in their action; each one can only attack substances of a definite chemical structure and moreover, in the case of isomeric substances, only those having the same stereo-chemical arrangement of their molecules. The way in which these substances act is the subject of research at the present time. It seems probable that a ferment combines with the material it affects, known as the substrate, and that this combination then takes up water and breaks down into simpler molecules, setting free the ferment which can then combine with another portion of the substrate. This is supported, as Bayliss has shown, by the time relations of ferment action at different concentrations. The likelihood of such a combination is also upheld by the fact that a ferment can resist the action of heat to a much greater degree when in the presence of its substrate. Invertase, for instance, is destroyed at 60° C., but when mixed with cane sugar can survive a temperature 25° higher.

The products of ferment activity have a retarding effect upon the reaction; it is interesting to note that only those products exert this inhibition which have a definite stereo-chemical structure and it is supposed that this may be similar to that of the ferment. Thus the activity of the lactase which hydrolyzes lactose to glucose and galactose is hindered by galactose but not by glucose.

It is possible that the combination between a ferment and its substrate is similar to that occurring between a toxin and an anti-toxin or a lysin and anti-lysin. According to the theory of Ehrlich a toxin is a molecule with a side chain, called the haptophore group, which can hook on to a tissue molecule, and another side chain, the toxophore group, to which the poisonous action of the toxin is due. The anti-toxin is supposed to neutralize the toxin by combining with the haptophore group which is therefore prevented from attaching itself to the tissues. Evidence has been brought forward to show that the combination between a toxin and an anti-toxin is not simply a chemical one. For instance, a certain quantity of toxin may be neutralized by a definite quantity of anti-toxin, but if the solution be diluted the neutralization is no longer complete. This and other considerations suggest that the combination may belong to a class of reactions partly physical in nature, known as the phenomena of adsorption, which have been observed in substances in the colloid state, that is to say, consisting of aggregates of molecules with a very large amount of surface. Near the surface of such suspended aggregates the concentration of molecules dissolved in the solution is different to that elsewhere and this affects the velocity of reactions taking place between them. Now the food-stuffs upon which the ferments act are colloid in nature, and it is probable that the ferments are too, and if this be so, it may be found that the mode of operation of the ferments of the body belongs to this physico-chemical group of reactions.

We may now follow the food-stuffs through the **stomach** and **intestines.** The food material passed from the gullet into the stomach lies in the cardiac part or fundus. In this mass salivary digestion goes on for a considerable time. Hensay found that in healthy young people 60–80 per cent of the carbohydrate food taken was dissolved in the stomach in one-half to three-quarters of an hour. It has also been shown that in rabbits, guinea-pigs, and cats salivary digestion goes on for a considerable time in the cardiac part of the stomach. In horses, pigs, and rats, the same is true, but in these animals the cardiac glands do not secrete acid. The action of ptyalin is stopped by the hydrochloric acid of the gastric juice, and the juice begins to be secreted even before food is taken into the stomach. It does not, however, permeate the mass of food lying at the cardiac end for half an hour or more, only attacking the outer portions which, as they become semi-fluid, are squeezed on into the pyloric part of the organ.

The **gastric juice** is a clear fluid containing water, salts, ferments, and ·2–·4 per cent of hydrochloric acid. Probably the acid is combined loosely with protein, for it does not behave to reagents as a pure solution of the same strength. The presence of acid is necessary to enable the ferment pepsin to hydrolyze protein to acid albumin, albumoses and peptone; and the combination of hydrochloric acid with protein is still able to exert this favourable influence upon peptic action.

The secretion of gastric juice takes place in two phases. In the first place the thought of food, the introduction of food into the mouth, and the chewing of food all call forth a flow of juice in a hungry individual, known as the appetite juice. In a dog with an œsophageal fistula, through which the food swallowed drops out, large quantities of juice may be collected from a fistula in the stomach when the animal is allowed to chew meat. Thorough mastication has also been shown to increase the amount of juice in man. The great importance of appetite has always been recognized and is well illustrated by Pawlow's observation that if a dog has been fasting, the sight of any food will produce gastric juice, whereas if it has been recently fed, and its appetite abated, there is only a flow if food be shown to which it is specially partial. The observations made many years ago by Beaumont upon Alexis St. Martin anticipated much of the work which has since been done. More recently, experiments on man have confirmed many of the results obtained by Pawlow on dogs. If food be introduced into the stomach of a dog without its knowledge, no juice flows for a considerable time. For example, a piece of meat was placed in the stomach of a dog through a gastric fistula, and 6 grammes of it were dissolved in an hour and a half. When, however, the appetite was excited by sham feeding, the food given passing out through an œsophageal fistula, 30 grammes, or six times as much, of the meat placed in the stomach was dissolved in an equal time. Schule has found that patients to whom food was given without their knowledge through a sound, after washing out the stomach, digested but little of it. By a similar procedure Lang found that some secretion was produced by meat, but none by carbohydrate. The flow of appetite juice is excited reflexly through the vagus nerve; it is important to note that any pain or discomfort inhibits the secretion.

The second phase of the secretion of gastric juice is called forth in the stomach itself (Edkins), and is probably independent of all nervous connexions. The products of digestion apparently cause the formation of some substance in the mucous membrane which is carried by the blood to the glands and stimulates them to secrete. This method of exciting secretion has been called a chemical reflex, and the substance producing it is known as a hormone (Bayliss and Starling), from *ὁρμαω*, arouse or excite. The bodies which most easily cause this second flow of juice are the products of protein digestion, and it follows that the appetite juice is necessary to start digestion in order that they may be formed. Similar bodies are, however, contained in meat broth, and this has been shown to stimulate the second flow of juice in man and in dogs. When the appetite juice is wanting, broth or soup may, therefore, act in some degree as a substitute.

The total amount of gastric juice produced is proportional to the amount of food, but the rate of flow varies with the nature of the food; a dry food, such as bread, exciting more flow in the first hour, whereas with meat and with milk the maximum is reached later.

The mass of food lying in the fundus of the stomach is gradually dissolved by the gastric juice. The **muscular wall** of the cardiac end is at this time in a state of tonic contraction; as the solid material becomes fluid it is squeezed by this pressure into the pyloric end. The division between the cardiac and pyloric parts is known as the pyloric antrum, and is easily distinguishable during life, though not in dissecting room specimens; it may often be seen in the post-mortem room; indeed, the pyloric part is sometimes so contracted as to be similar in appearance to the duodenum. About half an hour after the food has passed into the stomach waves of constriction begin at the antrum and pass towards the pylorus. Each wave takes about half a minute in its passage, and as a wave starts about every ten seconds two or three can be seen in the pyloric part of the stomach at once. These energetic contractions of the pyloric end can exert a considerable pressure and have the effect of moving about and rubbing down the food. When the hydrochloric acid of the gastric juice has combined with all the protein present the further secretion of juice results in the presence of free acid, and this acid appears to stimulate the muscular walls to yet more active contractions.

These movements of the stomach have been observed in the exposed organ, in normal animals and man, and by means of the X-rays, food mixed with nitrate or carbonate of bismuth having been previously given. They have also been seen in the excised organ and are therefore independent of its nervous connexions. Nevertheless, the muscular walls of the stomach are influenced by nerves, for stimulation of the vagus has been shown to increase the movements; and in animals in which these nerves have been divided the passage of food out of the stomach is much delayed. As the stomach contracts the body of the organ is lifted up towards the fixed cardiac orifice, so that the pylorus is the lowest point, and when it opens the chyme will pass out of it by gravity. Link found in a number of observations on man that the food was discharged more rapidly if the patient lay on the right side.

The **rate at which food leaves the stomach** varies according to its nature. Cannon found with the X-rays that carbo-hydrate foods, such as potatoes, begin to pass through the pyloric orifice without much delay. Proteins, except egg white, do not leave at all in the first half hour, and pass out more slowly. Fats begin to leave before proteins, but take a still longer time to be completely discharged. The explanation of these facts is of considerable interest. It appears that the pylorus begins to open as soon as a certain proportion of free acid is present. Carbo-hydrate food has no neutralizing effect upon the gastric juice and consequently the degree of acidity required to bring about relaxation of the pylorus is soon attained. Proteins, on the contrary, combine with hydrochloric acid and the acid first poured out must satisfy the affinity of the protein before any can be free in the stomach and stimulate the pyloric mucous membrane. It must be remembered that the proteolytic activity of pepsin can go on without free acid provided that the combination of acid with protein be present. If this explanation be the true one we should expect that the discharge of food from the stomach would be delayed by the addition of alkali and hastened by acid, and this was found by Cannon to be the case.

When a sufficient degree of acidity has been reached the pylorus opens and allows a small portion of the chyme to pass into the duodenum. The presence of acid in the duodenum causes a closure of the pylorus (Hirsch and Serdjukow) so that each portion of acid chyme which is squirted into the duodenum will, until it has been neutralized by the alkali of the bile and pancreatic juice, inhibit the passage of any more. The interval between the discharges is longer with protein than with carbohydrate, because not only has the free acid to be neutralized but also that in combination. As soon as the chyme is rendered neutral the inhibition is suspended, the pylorus again opens in response to the stimulus still acting in the stomach and a new consignment of chyme is forwarded. While this is going on the food remaining in the cardiac end of the stomach is being gradually dissolved in its turn and passed on to be churned in the pyloric end. The amount of acid juice does not increase indefinitely, for hydrochloric acid in sufficient quantity inhibits the secretion of more.

Fat leaves the stomach very slowly; its presence in the duodenum has, like acid, the effect of causing the pylorus to close. Consequently fat does not accumulate in the small intestine, but is dealt with by the bile and the pancreatic juice in small quantities at a time.

Water does not appear to be absorbed in the stomach but is passed on quickly into the duodenum.

In the small intestine the chyme is mixed with the pancreatic juice, the bile, and the intestinal juice, which are poured out into the lumen of the gut just at the time that the material upon which they are to act arrives. This is brought about by a most interesting mechanism for the discovery of which we are indebted to Bayliss and Starling. The acid of the chyme as it passes into the duodenum acts upon a substance in the mucous membrane known as prosecretin, with the result that a body, named secretin, is formed and carried by the blood vessels to the pancreas which is thereby stimulated to produce its digestive juice. At the same time, and by the same means, a flow of bile and of the intestinal juice of the upper part of the small intestine is also excited. All these secretions are therefore stimulated by the hormone secretin, the mechanism being chemical and not nervous; for in the case of the pancreas it has been shown that the secretion is independent of any nervous connexions; all that is necessary is that acid shall be introduced into the duodenum and that the blood vessels shall be intact.

The **pancreatic juice** is a clear, strongly alkaline albuminous fluid, containing ferments. These are, however, only brought to their full activity by mixture with the succus entericus and bile, and this is especially the case with the proteolytic ferment. Pancreatic juice has very little action on protein, but is converted into a powerful agent by the addition of a small quantity of intestinal juice. This is due to a ferment in the succus entericus, known as enterokinase, which has the property of activating the trypsinogen of the pancreatic juice to form trypsin. Trypsin has, in an alkaline medium, a strong proteolytic action, forming first alkali-albumin, then albumoses, peptone, and aminoacids. Pancreatic juice also contains an amylase, called amylopsin, and the fat splitting ferment steapsin. The alkalinity of the juice is proportional to the acidity of the chyme which it neutralizes. Pawlow has brought forward evidence that the amount of each ferment in the pancreatic juice varies with the nature of the food, but these results have not yet been fully confirmed by other workers.

The albumoses and peptones of the chyme are broken down by trypsin, to a large number of bodies belonging to the class of aminoacids. The action is a far reaching one and is a process of hydrolysis, although the products show some differences from those of hydrolysis by acid. It is found experimentally that the digestion of protein by pancreatic juice is most complete when, as is the case in the body, the protein has been first subjected to the action of the gastric juice. The following (from Aders Plimmer) are some of the chief substances formed :—

Monoaminocarboxylic acids :
- Glycine
- Alanine
- Leucine
- Phenylalanine
- Serine, Tyrosine } oxy-aminoacids
- Cystine, Cysteine } ortho-aminoacids

Monoamino-dicarboxylic acids:
- Aspartic acid
- Glutamic acid

Diaminomonocarboxylic acids (hexone bases):
- Ornithine
- Lysine
- Arginine
- Histidine

Heterocyclic compounds:
- Proline
- Oxyproline
- Tryptophane

These bodies are the fractions of which protein is made. We shall see later that the proteins of the body have a characteristic structure which is by no means the same as that of those in the food. In the process of digestion the complex molecules of the food proteins having been broken down into simpler ones, these are picked out in certain proportions to build up the tissues of the body, in the same way as the stones which have served for one house may be used again to construct a new building of a different architecture.

The amylolytic ferment of the pancreatic juice has a similar action upon starches to that of ptyalin, the chief product being maltose with a little dextrose. Its activity is doubled, according to Pawlow, by the presence of bile. In young animals a lactase is also present which converts lactose to dextrose and galactose.

The lipase, or fat splitting ferment, converts fats into fatty acids and glycerine: bile increases its action threefold.

Both pancreatic and gastric juice contain ferments which throw caseinogen out of solution, the rennin ferments. It is probable that their action is not identical in the two cases. These ferments are closely connected with pepsin and with trypsin. They do not exist for the sole purpose of clotting milk, for they are present in animals which take none, for instance, in fishes. Some observers have put forward the view that they play a part in the synthesis of protein, but this is by no means proved.

Glaessner, in a case of pancreatic fistula, has investigated the properties of the juice in man and was able to confirm the facts which had been established by experiment upon animals. Five to eight hundred cubic centimetres of juice were secreted daily by his patient.

The bile contains water, mucin, the bile salts—sodium taurocholate and glycocholate—the bile pigments, cholesterin, lecithin, and inorganic salts. The assistance given by the bile in the digestion of fat is due to the tauro- and glycocholate of soda, which have the property of lessening the surface tension between the fats and the intestinal fluids and by this means aiding emulsification and enabling the lipase to come into closer relationship with the fat. The bile salts, by dissolving the fatty acids or soaps produced, also aid their absorption. The function of the cholesterin is not understood. It has been regarded as an excretory product of nervous tissue, but J. A. Gardner has recently shown that if there be no cholesterin in the food there is none in the fæces, although it is still contained in the bile; it has long been held that the bile salts are absorbed from the intestine and re-secreted in the bile to help again in the digestion of fat, and it appears probable from these researches that cholesterin is also re-absorbed. Lecithin has been found by Parker and Moore to aid the solution of soaps by bile salts. The pigments of the bile are true excretory products derived from the hæmoglobin of the blood.

The succus entericus is an alkaline fluid containing small quantities of protein, mucin, leucocytes and epithelial cells, and at least three ferments. We have already referred to one of these, enterokinase. Another ferment called erepsin (Cohnheim) breaks down albumoses and peptones to the various aminoacids enumerated above, and its presence in the small intestine ensures that any protein not fully disintegrated by pepsin and by trypsin shall not escape. Erepsin is also able to attack fibrin and caseinogen. An invertin ferment or invertase is also present which inverts cane sugar to dextrose and levulose; a maltase which converts maltose into dextrose; and, in young animals, a lactase. The carbo-hydrates are by these means entirely hydrolyzed to dextrose, levulose or galactose. It is not, however, certain that this takes place entirely in the lumen of the gut, for it is probable that the ferments, to some extent at least, produce their effect within the mucous membrane.

The digestion and absorption of the food is materially aided by the **movements of the small intestine.** It has been shown by direct observation and by the X-rays that during digestion the gut is continually kept in motion by the passage along its muscular walls of circular constrictions which have the effect of dividing up the contents into small lengths without moving them onwards. These short sausage shaped pieces are then further divided into two, each of which joins with a similar piece lying above or below it. The movements are repeated again and again with the result that the food materials and the digestive juices are thoroughly mixed, and every part of the whole is brought into intimate relation with the absorbing wall of the gut. At intervals a different kind of movement is seen, the peristaltic wave, which, by a prolonged constriction of a part of the intestine with a relaxation of the region lying immediately below it, propels the contents along the tube.

ABSORPTION

We have now traced the food materials through the upper part of the small intestine. However various in appearance and in composition the ingredients of the diet may have been, they are now, in a healthy person, reduced to a uniform semi-fluid consistence, and their proteins, fats, and carbo-hydrates have suffered chemical change under the influence of the digestive juices and are, in large part if not entirely, converted into a number of simpler chemical bodies, suitable for absorption by the epithelium of the villi. This process of absorption is most active in the ileum, although it takes place to some extent along the whole of the small and large intestine.

The means by which the epithelial cells of the gut are able to take up food substances and transfer them to the lymph and blood are imperfectly understood, and the experimental study of the problem is hedged about by difficulties. In the first place it is clear that absorption is selective, some substances being taken up much more readily than others.

In the case of inorganic salts this may perhaps be explained to a considerable extent on physical grounds, for those salts which, when dissociated, liberate slowly moving ions, are slowly absorbed. This is the case with magnesium sulphate and is one explanation of its action as a purgative, the Mg and SO_4 ions thus remaining in the intestine and attracting fluid by their osmotic tension until the gut is distended, and stimulated to pass the whole on. Solutions of salts in the intestine do, in great measure, follow the laws of osmosis through semi-permeable membranes, a hypertonic solution attracting water from the blood and lymph and a hypotonic losing water, with the result that the saline solution in the gut becomes isotonic with the blood and lymph ; it is then gradually absorbed, presumably because the partial pressure of that particular salt is less in these fluids than in the solution, and because the epithelium is more permeable to that salt in the direction from the lumen to the blood. Osmosis through a semi-permeable membrane will not, however, fully explain the absorption, for salts which have similar physical properties, such as rapidity of movement of their ions, are not taken up at equal rates. The facts that an animal can take up water and salts from its own serum, and that the excised gut when placed in the defibrinated blood of the same animal will take up fluid into its mucous membrane, also indicate that even in the case of inorganic salts, and probably of water, the epithelium has some direct selective activity, and that there is a general tendency for water and some salts to pass inwards. This does not imply that physical factors are not of great value. Nature uses all the means at her disposal. No one doubts that when water is taken into the intestine of a thirsty person the raised osmotic tension of the water-poor fluids of the body accelerates its absorption. Nevertheless the facts at present available as to the absorption of salts are not fully explained by physical conditions, and it is as well to speak plainly of a selective absorption as to shelter the same idea behind the phrase of a membrane possessing special permeabilities.

The absorption of the food-stuffs is a different matter, for it is probable that each of them is altered in its passage through the epithelium.

In the case of **the proteins** the former hypothesis that they are taken up in the form of albumoses and peptone is giving place to the view that the object of digestion is to break them down still further to the aminoacids which we have enumerated above, and that these bodies are absorbed, and either oxidized to furnish energy or rebuilt into fresh protein. It is still possible on this view that some protein is taken into the epithelial cells as albumose or peptone, for the ferment erepsin which is believed to complete the disintegration into aminoacids probably acts in the mucous membrane as well as in the lumen of the gut. It is important to note that protein loses but little potential energy in the course of its transformation into these amino-bodies.

If the assumption that proteins are absorbed in this form be correct, it should be possible to maintain nitrogenous equilibrium upon a mixture of the aminoacids; this has been shown to be the case. The nitrogenous needs of dogs and rats have been satisfied for considerable periods by the material obtained by the digestion of casein in vitro until no albumoses or peptones remained. In such a diet it is necessary that all the essential fractions required to build up the body protein shall be present. A diet of gelatine, for instance, cannot play the part of protein because, although gelatine yields many aminoacids on hydrolysis, it cannot furnish tyrosine, or tryptophane, or cystine, all of which are needed to form the higher proteins; if, however, those bodies be added there is evidence that gelatin can replace true protein in the diet. Zein, again, a protein obtained from maize, has been shown by Willcock and Hopkins to be more efficient as a food if tryptophane, which is missing from its decomposition products, be added to it.

If we conclude that the epithelial cells take up aminoacids from the gut, we have still to inquire whether these bodies are passed into the blood in this form. A portion of the amino-bodies at least must be built up somewhere into the body protein. Some authorities, for instance Abderhalden, have expressed the view that this is done in the wall of the intestine. Leathes has, however, brought forward evidence to show that there is a definite though small increase in the non-protein nitrogenous bodies in blood flowing from the absorbing intestine, and v. Bergmann has found amino-bodies in such blood. If the amino-bodies pass into the portal blood we should suspect that their elaboration might take place in the liver; this is supported by the fact that if the portal blood be led into the vena cava without going through the liver (Eck's fistula) symptoms of poisoning occur when the animal is fed upon meat, indicating that the liver plays an essential part in the assimilation of such food. It is also possible that some, or a great part, of the aminoacids may be taken, as such, directly to the various body cells. It is interesting to note that in plants nitrogen is absorbed into the sap in the form of aminoacids, formed by the breaking down of the seed proteins.

Nitrogenous material is taken up entirely by the blood and not by the lymph, for even on a rich protein diet the amount of nitrogen in the chyle is not materially raised.

Carbohydrates are absorbed entirely in the form of the monosaccharides and, on an ordinary diet, chiefly as dextrose, with small quantities of levulose, and as galactose. The conversion of maltose to dextrose is probably completed in the intestinal wall. The sugar is taken up by the blood, for it does not appear in the lymph of the thoracic duct. The passage of dextrose from the cell is, no doubt, aided by osmosis, for there will be a fall of pressure from the bowel to the blood. The portal blood carries the sugar to the liver where it is stored as glycogen.

We have seen that **the fats** are prepared for absorption by being emulsified in the mixture of juices in the small intestine, with the help of the bile; they are then more easily attacked by the fat splitting ferment of the pancreatic juice. The procedure is probably as follows. The ferment splits about five per cent of the emulsified fat into fatty acid and glycerine. In the presence of the alkaline juices the fatty acid combines with the base present, for example, sodium, and forms a soap; both soap and fatty acid are dissolved by the bile salts and are therefore presented to the epithelial cells in solution and taken up by them. In the usual case the contents of the gut are alkaline and the fat will be absorbed as soap; when the reaction is acid, as it is sometimes, the absorption will take place of the fatty acid. The removal of the fatty acid or soap will leave the steapsin free to split another five per cent of the fat in the intestine and this will go on until all is converted and absorbed.

The absorbed fatty radicle, whether acid or soap, is re-united with glycerine somewhere in the wall of the gut to form again a neutral fat (Munk). This is probably effected by a reversible ferment action working in the opposite direction to the lipase in the pancreatic juice, though no ferment could be separated by B. Moore from an extract of the mucous membrane. The same observer has shown that after a fatty meal the mucous membrane of the intestine contains 15 to 35 per cent of its fat in the form of fatty acid, whilst in the lymphatics of the mesentery only 5 per cent is in that form, the remaining 95 per cent being neutral fat which has, therefore, been re-synthesized before leaving the wall of the bowel. No loss of energy is involved in the transformation either way between fat and fatty acid. The microscopical appearances of the epithelial cells when stained with osmic acid do not enable us to distinguish between fatty acid and fat, as both of these take the stain.

Fat is absorbed by the lymphatics and passed into the thoracic duct, and thence into the subclavian vein, reaching, therefore, the general circulation without having been through the liver. About 60 per cent of that absorbed can be recovered from the duct; the fate of the remainder is not clear, but as the blood of the portal vein has not been found, during digestion, to contain more fat than that of the systemic arteries it is supposed that it is not taken up into the blood.

Water is absorbed along the whole length of the small intestine, but probably not in much greater quantity than is poured out in the intestinal juices, for the contents of the ileum remain in a semi-fluid condition until the cæcum is reached. It is in the colon that the absorption of water chiefly takes place. If the food be mixed with bismuth the first part of it can be observed to arrive at the cæcum four or five hours after the meal. As it passes out of the ileum it fills up the ascending colon, and this excites waves of contraction which pass backward from the transverse colon to the cæcum and keep the semi-fluid mass from moving along: this delay in the colon enables water to be taken up, as well as the residue of food-stuffs.

As the fæces become drier and fill up the transverse colon, true peristaltic waves are from time to time excited which pass the distal portions of the mass into the descending colon and sigmoid flexure, whence they are periodically discharged in **defæcation.** Hertz found that food mixed with bismuth reached the hepatic flexure in 6½ hours, the middle of the transverse colon in 8, and the splenic flexure in 9 hours after the meal. This refers to the daytime. During sleep the movements of the intestine are more sluggish.

THE DIGESTIBILITY OF FOOD-STUFFS

The unabsorbed parts of the food are discharged from the body in the fæces, which do not, however, consist solely of such matter but also contain products derived from the intestine. The undigested residue consists of the remains of tendon, ligament, elastic fibre, blood vessels, muscle fibre and other cells of animal food; of fat, cholesterin, and the cleavage products of protein; of vegetable fibre (cellulose), starch granules, and derivatives of chlorophyll; of calcium and magnesium salts of fatty acids, and magnesio-ammonium phosphate. The metabolic products in the fæces, derived from the intestines, are epithelial cells, mucus, and the residue of the digestive juices.

We may find out how much of any given food is absorbed by a study of the composition of the dejecta, because any portion of it not taken up by the gut will be found in them. It is clear that this method of determining the absorbability or digestibility of foods is not quite accurate unless we can recognize how much of the fæces is composed of the metabolic products, and this cannot at present be done. Nevertheless the results are sufficiently near to be of great value: no carbo-hydrate is excreted from the intestine and therefore all the vegetable fibre in the fæces is derived from the food: the amount of nitrogen passed out as metabolic products, such as digestive juices and epithelial cells, is small and can be allowed for; and the same applies to the non-fatty ethereal extractives of the fæces, which add to the apparent amount of fat. It is of obvious importance in the study of dietetics to know how much of the food ingested is actually taken up and made available for the needs of the body. The following table (from Atwater) summarizes the results obtained from a number of ordinary foods. These figures are obtained by experiments in which a healthy individual was fed upon one food-stuff only, with condiments, usually for at least three days. Allowance is made for the metabolic products and the figures are therefore higher than those of many published tables.

Animal Foods.	Percentages Digested.			Vegetable Foods.	Percentages Digested.		
	Protein.	Fat.	Carbohydrate		Protein.	Fat.	Carbohydrate
	P. ct.	P. ct.	P. ct.		P. ct.		
Beef and Veal.	100	95	—	Wheat flour, fine . .	85	80 per cent assumed for all.	95 per cent assumed for all.
Mutton . .	100	95	—	Wheat flour, medium .	81		
Pork . . .	100	95	—	Wheat flour, coarse . .	75		
Fish and Oysters. . .	100	95	—	Rice . . .	85		
Milk . . .	100	96	100	Macaroni. .	85		
Cheese . .	100	95	100	Rye flour. .	78		
Butter . .	—	96		Maize meal .	85		
Oleomargarine	—	95	—	Potatoes . .	75		
Tallow . . .	—	95	—	Cabbages, turnips, etc .	80		
Lard . . .	—	95	—	Beans . .	85		
Oils . . .	—	95	—	Peas . . .	85		
Eggs . . .	100	98	—				

Magnus Levy found that on the average 8 per cent of the total dry substance of milk was lost, 7 per cent of meat, and 5 per cent of bread. On pure vegetable foods the loss was 10 per cent.

These figures show that the protein and fat of animal foods are much more completely absorbed than those of vegetables, with which there is a loss in the fæces of 15 to 25 per cent of the protein. In calculating the value of a vegetable diet allowance should be made for this, and more than the apparent needs supplied. The reason for the loss is that the nitrogenous matter of vegetables is mixed with masses of cellulose and starch which render it difficult for the digestive juices to reach the protein and dissolve it. Observations on the digestibility of foods in vegetarians have shown that the waste does not diminish in those who have been accustomed to such a diet for years. Hence on a purely vegetarian diet, to quote Chittenden, " an excess of work is thrown upon the alimentary organs which not only causes discomfort but is a physiological loss, entailing the working over by the system of large quantities of material in order that the required amount of protein matter may be obtained." This does not mean that it is desirable to take our carbo-hydrates entirely in the more absorbable forms of fine meal or sugar, for a moderate admixture of vegetables with other food is an advantage on account of the stimulus to the alimentary movements which their bulk and fibrous nature afford. Of the animal foods, those meats which have short and delicate fibres are the most digestible, such as the breast of young chickens : strong and tough fibres resist disintegration. Again, muscle fibres which are intimately mixed with fat, as are those of the eel and lobster, are not so easily attacked by the digestive juices.

Similar considerations apply to vegetable foods : thus Rübner found that the digestibility of starch depends upon the ease with which the juices can reach it ; with fine meal the loss of carbohydrate was only 1·1 per cent, with coarse meal 2·6 per cent, with whole corn 7·4 per cent, and in carrots 18 per cent. Such high figures as this last do not occur when other foods are taken as well.

Indeed, results obtained by studying the digestibility of one food at a time, valuable as they are, do not necessarily apply to a mixture of foods, and we must now look at the results which have been obtained on various dietaries.

Atwater found the absorption of an ordinary mixed diet, in a large number of observations, to be as follows :—

Protein, 90–93 per cent, Fat, 95–96 per cent, Carbo-hydrate, 97–98 per cent, Calories used, 90–93 per cent.

The digestibility is equally good with large amounts of food. In a patient in bed undergoing special feeding upon an enormous and varied diet Hale White and the writer found the utilization of protein and of fat to be 96 per cent.

Muscular work does not diminish the digestibility of foods, for in training Atwater and Sherman found the following absorption figures :—

Protein, 93 per cent, Fat, 93 per cent, Carbo-hydrate, 99 per cent.

On a fruitarian diet the digestibility is lower, as we should expect from the studies on individual foods. Jaffa found that the average of 30 digestion experiments on fruitarians gave :—

Protein, 75 per cent, Fat, 86 per cent, Sugar, starch, etc., 95 per cent, Fibre, 79 per cent, Calories, 86 per cent.

These figures are not markedly different in childhood, for a child of seven years, feeding on apples, bananas, oranges, dates, honey, olive oil, almonds, pignolias, and walnuts, digested the following proportions :—

Protein, 82·5 per cent, Fat, 87 per cent, Sugar, starch, etc., 96 per cent, Fibre, 80 per cent, Calories, 87 per cent.

The results of digestion experiments as a whole may be summarized in the following words (after Atwater). Animal protein is readily and completely digested, that of vegetables less completely. Of potatoes and beans, for instance, one third may escape digestion and thus be useless as nourishment. Fats are on the whole well digested. The carbo-hydrates in general are digestible except the crude fibre or cellulose, but the amount of this in an ordinary diet is small.

The digestive powers of different individuals differ less than is commonly supposed. We are here referring to the utilization of the food and not to the length of time which it remains in the stomach or the symptoms it may excite there, for the relative ease of digestion and the time it takes vary in different individuals to a considerable degree. Flavouring materials appear to have but little effect upon the utilization of the food.

NUTRITION

We must now consider briefly the fate of the food-stuffs after absorption and the way in which they serve to nourish the body. When we attempt to trace the course and the transformations of these materials from the time that they disappear from the intestine to the final reappearance of their elements as urea and water in the urine, and carbon dioxide and water in the expired air, we find ourselves plunged at once into the most difficult problems of physiology, a full discussion of which, however interesting to the student of dietetics, would not in the present state of our knowledge,or rather our ignorance, yield any practical information bearing upon dietetics. We shall therefore confine ourselves to a brief summary of the modern view as to the processes by means of which foods are oxidized to furnish energy, or built up into tissues.

When a meal of **protein** is taken the major part of the nitrogen which it contains is excreted in the urine in a short time ; if protein be introduced directly into the intestines of an animal the same is true ; as much as 40–50 per cent of the nitrogen may appear in the urine within a couple of hours. These facts, which were formerly supposed to show that the tissues preferred protein food and therefore used it up at once, are now regarded as evidence that the nitrogenous part only of the protein molecule is thus rapidly passed out, and that the rest of the molecule is kept in the body for immediate or future use (Folin) ; it is not oxidized simultaneously with the excretion of the nitrogen, for the heat given off is not greater after a meal of protein. Since protein foods are absorbed in the form of aminoacids we must suppose that the nitrogen is split from these bodies as ammonia. It is not known for certain where this splitting takes place but it is probable that it is within the intestinal wall. Nencki has shown that there may be four times as much ammonia in the portal blood during digestion as in the systemic circulation, and this ammonia may be that split off from the aminoacids on its way to the liver to be converted into urea and passed out in that form in the urine. The denitrified remainder of the aminoacid would still possess a considerable caloric value. A gramme molecule of leucin, for instance, furnishes on combustion 130 calories ; and the oxyacid which may be supposed to be formed by the denitrification of leucin gives 110 calories. The denitrification of glycocoll, again, would only involve a loss of about 15 per cent of its heat value. The steps in the oxidation of the denitrified oxyacids are not understood but it is theoretically possible that sugar may be elaborated from them. This would explain the formation of the large quantities of sugar that are believed to be derived from protein, for although the carbo-hydrate derivatives, such as glucosamine, obtained from protein by comparatively simple methods, may give rise to some sugar, the total quantity of these glycoproteins is small and is inadequate to furnish the amount which may under special circumstances, in diabetes, for example, be formed from protein. It is also theoretically conceivable that fat may be synthesized from these oxyacids.

The above considerations only deal with that proportion of the nitrogenous food which is not required for building up protein tissues, for which purpose there must be a **synthesis of protein** from the aminoacids absorbed. Many facts speak in favour of such a synthesis, though it is not known whether it takes place in the intestinal wall, in the liver, or elsewhere. The proteins we eat are different in composition from those of our own tissues ; they do not on hydrolysis yield the same proportions of the various aminoacids. The following table (adapted from Aders Plimmer) shows what great differences exist between

Proteins.	Percentages.					
	Arginine.	Glutamic Acid.	Lysine.	Histidine	Tyrosine.	Cystine.
Caseinogen	4·8	11·0	5·8	2·6	4·5	0·1
Egg albumin . . .	—	8·0	—	—	1·1	0·2
Serum albumin . .	—	—	—	—	2·0	2·1
Gelatine	7·6	0·9	2·7	0·4	—	—
Zein (from maize) . .	1·8	—	—	0·8	—	—

various proteins. It is reasonable, therefore, to suppose that the body may select in certain proportions the aminoacids presented to it in order to build up any particular tissue. We have already referred to the experiments of Kaufmann and of Willcock and Hopkins upon diets of gelatine and zein, which show that particular aminoacids are needed in the diet. It appears that, whatever is supplied, the body makes its proteins of a particular type. Abderhalden bled a horse severely so that a considerable quantity of the serum protein was lost. The animal was then fed upon gliadine, which contains four times as much glutamic acid as the serum protein; but in spite of the absorption of gliadine the composition of the serum protein remained the same. Again, when the vegetable protein, zein, is given as food it cannot be recognized in the tissues and is therefore completely broken down, its constituents, or part of them, being built up into other proteins. Hence it is always desirable to supply protein in the diet in excess of the actual requirements, in order that there may be plenty of choice; and especially when the protein of the food is derived from vegetables, for if the aminoacids resulting from the hydrolysis of the protein of the food are not present in the same proportions as are needed to build up tissues, and this is likely to be the case with vegetable proteins, it is clear that in the selection of the suitable groups many will be rejected and can only serve for oxidation purposes.

A diet may therefore be deficient in the quality of its protein constituents whilst sufficient in their quantity. In mothers' milk it is probable that the necessary ingredients are present in exactly the right proportions, in which case the digestive breaking down and the subsequent building up may be supposed to go on with a minimal waste. Abderhalden suggests that in such a disease as rickets it is possible that there is a deficiency of a qualitative nature and that the cells of the growing tissues suffer because they are not supplied with a particular material. Some substances are especially necessary to healthy existence. Adrenalin, for instance, is essential; it is derived from an aromatic precursor, and Hopkins points out that "it is probable that the suprarenal gland requires a constant supply of some one of the aromatic groups of the protein molecule to serve as an indispensable basis for the elaboration of adrenalin." In starvation such a precursor would have to be obtained by tissue breakdown outside the gland.

It appears then that the cells of the body are offered protein of a constant form, that of the serum albumin and serum globulin of the blood and lymph. It is possible, and even probable, that a second process of digestion now takes place and that the cell breaks down their material and rebuilds it into its own tissue. It is also possible that some aminoacids are conveyed by the blood directly to the cells, and that the cells select what they require.

Lastly, we must inquire by what means the **constant disintegration of living tissue** is carried out. If an organ taken from the body be kept under aseptic conditions it undergoes a chemical dissolution known as autolysis, and the products found are similar to those obtained by the hydrolysis of protein in other ways. This liquefaction is attributed to ferment action. It is probable that the removal of inflammatory products, such as the exudation into the pulmonary alveoli in pneumonia, takes place by this means. But even in the healthy body portions of cells are always dying and there is a good deal of evidence to show that this normal disintegration of tissue is also due to enzymes and is analogous to or even identical with the autolytic action observed after death. The blood serum appears to contain an anti-ferment inhibiting this action, and may be supposed to prevent a too general autolysis. On such a view the anabolism and the katabolism of the tissues is the result of antagonistic ferment actions the balancing of which results in perfect health.

The aminoacids formed by the breaking down of cells are carried to the liver, where their nitrogen is converted into urea and excreted, probably in just the same way as the surplus nitrogen from the food is got rid of immediately after its absorption. A proportion of the nitrogen of the urine, however, is not in the form of urea but of uric acid and other purin bodies, and of ammonia and creatinine. These nitrogenous substances, especially the creatinine and uric acid, result from cell metabolism or the metabolism of structure, and, with part of the urea, represent the "endogenous" metabolism of nitrogen. The remainder of the urea is regarded as derived from the nitrogen of the protein which is rapidly excreted, and may be called exogenous.

The special metabolism of purin bodies will be reviewed in another part of this volume.

The creatinine in the urine has generally been regarded as mainly derived from muscle, and although some doubt has been thrown upon this, the writer has brought forward pathological evidence supporting the original view, having confirmed the observation, made long ago, that in muscular atrophies the excretion of creatinine is greatly diminished.

The fat absorbed in the intestine and passed into the thoracic duct is carried into the general circulation, and, if not at once needed for oxidation, is deposited in connective tissue cells in the fat depots of the body, especially in the subcutaneous tissue, in the omentum and around the kidneys. The fat stored in this way is of the same kind as that in the food. This has been shown by feeding animals upon special forms of fat, which have then been recognized in the tissues either by their melting points or by their powers of combining with iodine, which differ in different fats. Hence fat is deposited without undergoing any fundamental assimilative change. This is the direct opposite to what we have seen occurs with protein. The two cases are not, however, really analogous, for the depot fat cannot be regarded as actually forming part of the living tissues; and we shall see later that when fat is built up into tissues there is evidence that it undergoes considerable change. This deposited fat is used in lactating animals to furnish the fat of the milk, for the melting point of butter may be definitely altered by feeding a cow upon cotton seed oil or palm oil. Again if much linseed oil be given the milk will be of an oily nature; and sesame and almond oil have been shown to be present in the butter fat of a cow fed upon these foods. The fat of the sebaceous glands is also identical with that ingested.

The fat in the body, besides being derived from that in the food, may be formed from carbo-hydrate as was first proved by Lawes and Gilbert. In the formation of fat from carbo-hydrate we should expect that an excess of CO_2 would be liberated, which would appear in the expired air, and as a matter of fact a rise of the respiratory quotient above unity has been observed in man and animals fed, after fasting, upon an abundant carbohydrate diet (Hanriot, Pembrey). In the vegetable kingdom oils are of course synthesized and probably from carbo-hydrate. The steps of such a transformation are not yet worked out, but we may mention that sugar, under the influence of a ferment, can easily give rise to lactic acid, and that the liver appears to have the power of forming butyric acid, which is a lower member of the fatty acid group, from lactic acid. Experimentally, also, some of the lower fatty acids can be synthesized from bodies of a carbo-hydrate nature (Harden).

The evidence for the formation of fat from protein is conflicting ; it was formerly thought that protein could form fat, but a repetition of the old experiments has undermined a good deal of the evidence. For instance, in the case of animals fed for long periods upon protein only it had been found that fat was laid on, but it has since been pointed out that the small amount of fat remaining among the fibres of the meat given as food was sufficient to account for this. Again, the large droplets of fat which are to be seen in osmic acid preparations of the liver in phosphorus poisoning were taken as evidence of fatty degeneration, the fat being regarded as formed from the protein of the cells. This conclusion was not, however, justified, for in the first place the microscopical evidence of fat is an unsafe guide to the actual quantity present, as there may be less fat in a tissue which is apparently full of it than in a normal organ showing none in the form of droplets : secondly, the fat contained in such a poisoned liver has been shown by Rosenfeld to be derived, not from the liver, but from the connective tissue ; in the case, for example, of a dog first fed on mutton fat and then poisoned with phosphorus it was found that the fat in the liver was mutton fat. In an organ, then, which shows fatty infiltration the fat is not necessarily formed from the protoplasm of the organ but may accumulate in droplets because the poisoned cells are unable to utilize that which is brought in the blood.

The changes which take place when fat is oxidized are imperfectly understood. Although fat may be deposited in the tissues, and even excreted in the milk unchanged, recent work by Leathes and by Hartley suggests that it undergoes important assimilative changes before it is finally oxidized to furnish energy. The fats isolated from active organs such as the heart and the liver have a higher iodine value (that is contain less hydrogen) than those in the food. The iodine value of connective tissue fat, for instance, is 64; the fat of a degenerated liver has a value of 70; but that of a normal liver has a value of 120. It is probable, therefore, that the ordinary fats are transformed in the tissues into more complex substances, of which lecithin may serve as a type; and several lecithin-like bodies of great complexity have been found in the heart muscle. The study of these will probably yield information as to the mode of utilization of fat.

When fat is burnt in the body the respiratory quotient is low, for much of the oxygen taken in is required to oxidize the large amount of hydrogen which fats contain and this oxygen is excreted as water and does not appear in the expired air, with the consequence that the ratio $\frac{CO_2}{O_2}$ is depressed below unity, its theoretical value under these circumstances being ·7. The oxidation of protein gives a respiratory quotient of ·8, whilst if carbo-hydrate is alone being used the quotient observed should be unity.

Fate of carbo-hydrate.—The dextrose taken up in the intestinal capillaries passes by the portal vein into the liver. During digestion the portal blood contains from ·2 to ·4 per cent of sugar, whilst during fasting the amount is the same as in the general circulation, ·05 to ·2 per cent. The sugar taken to the liver is deposited there as the polysaccharide glycogen. The muscles also contain glycogen, and must have the power of forming it from the sugar carried to them in the blood, for no glycogen can be found in the plasma. The liver synthesizes dextrose, levulose, and probably galactose, that is the monosaccharides, to glycogen, which appears to be an identical product in each case. It is assumed that levulose is not first converted into dextrose and then into glycogen because in pancreatic diabetes levulose can form glycogen whilst dextrose cannot. Protein has long been regarded as a source of glycogen, although careful feeding experiments do not prove the point satisfactorily. Nevertheless, even if food proteins cannot be shown to increase the quantity of glycogen in the liver, it appears that the body protein can; for if rabbits are subjected to strychnine poisoning, which leads to the disappearance of all the glycogen from the liver and muscles, and are then put under the influence of chloral, glycogen is found to re-accumulate.

It is certain that sugar can be formed from protein, and though it is not known how far this takes place in health, or whether glycogen is a necessary intermediate stage, in diabetes a large part of the dextrose in the urine is known to be derived from the nitrogenous tissues.

There is a difference of opinion as to whether sugar is formed in the body from fat. We have already seen that when fat is being formed from sugar the respiratory quotient is above unity. Pembrey has shown, conversely, that in hibernating animals respiratory quotients as low as ·3 or ·4 may be observed. Since the normal oxidation of fat gives a quotient of ·7, such a figure as ·4 means that much oxygen is retained in the body, and it is reasonable to suppose that this is being used in the formation of carbo-hydrate, which contains much more oxygen than fat. Leathes suggests as another explanation that fat is imperfectly oxidized in the hibernating state. Further argument in favour of the formation of sugar from fat is derived from the study of diabetes. In this disease the ratio between the dextrose and the nitrogen in the urine, known as the $\frac{D}{N}$ ratio, when the patient is on a strict diabetic diet, there being no carbo-hydrate in the food, has frequently been found to be 11 or 12. Now supposing that all the carbon of protein could be excreted in the form of sugar, excepting that of the urea arising from the nitrogenous part of the protein molecule, the theoretical $\frac{D}{N}$ ratio could not be greater than 7. A higher figure, such as 11, means, therefore, that sugar has been derived from some other source than protein: as no carbo-hydrate is being taken, and the glycogen in the body is insufficient to explain the large excess of sugar, it is concluded that it is formed from fat.

The glycogen stored in the liver is discharged as dextrose into the hepatic blood to supply the carbo-hydrate needs of the body. The conversion of glycogen to dextrose takes place very rapidly after death, and is effected by an intra-cellular ferment, which can be extracted by suitable methods. The liver may be made to discharge glycogen experimentally by cold, by fasting, and by severe exercise, all these being conditions which call for a good supply of energy, and this carbo-hydrate food can furnish. The liver also loses its glycogen under abnormal experimental conditions such as after the diabetic puncture and under the influence of various poisons. We possess very little direct evidence as to how and where dextrose, whether it be formed from glycogen, or directly from protein or fat, is oxidized; the blood itself contains a weak glycolytic ferment, but it is improbable that this is responsible for the great destruction of carbo-hydrate which takes place in the body. The muscles are certainly the seat of oxidation of non-nitrogenous matter, but no glycolytic ferment can be extracted from muscle. Very suggestive, however, is the observation of Cohnheim that a mixture of muscle juice and pancreatic extract gives a strong glycolytic ferment. This would explain the occurrence of diabetes after excision of the pancreas, for then the combustion of sugar would presumably fail owing to the absence of the pancreatic constituent of this ferment. If Cohnheim's observations were fully confirmed we should conclude that sugar is oxidized in the muscles under the influence of an activating ferment from the pancreas. As the matter stands at present, however, those who have repeated these experiments have obtained conflicting results.

It is evident that our knowledge of the fate of food-stuffs in the tissues is very imperfect. Nevertheless great strides have been made in the last ten years in the study of this intermediate metabolism. These researches are of vital importance to the science of dietetics. Only as we understand the exact uses to which foods are put can we expect to adapt the diet wisely to all the varied needs of the individual, and to guide public opinion, both in respect to food and to general hygiene, along such paths as shall lead to the perfect development of the body and of the mind.

THE RESULTS OF EXPERIMENTAL WORK ON DIET

CHAPTER IV

THE RESULTS OF EXPERIMENTAL WORK ON DIET

BY E. I. SPRIGGS, M.D., F.R.C.P.

General Considerations.—Protoplasm can only live under certain narrow conditions, of which the presence of oxygen, a moderate degree of warmth and of moisture, and a more or less regular supply of food are the most obvious. In the highly developed mammalia, and especially in man, these conditions are far more stringent than in lower creatures, many of which are possessed of great powers of resistance, whereas man can only survive the absence of oxygen for a few minutes, of water for a few days and food for a few weeks. On the other hand the range of temperature in which man can exist and be active is wider than that of any animal, owing partly to the capacity which his body has of automatically maintaining itself at a constant temperature, a capacity shared with birds and mammals, and partly to the artificial protections against extremes of cold with which he has learned to provide himself.

In the matter of food man is entirely dependent upon animals and plants. Plants, by means of their chlorophyll, use the energy of the sun's rays to build up their tissues from inorganic matter, but, if we exclude oxygen, water and salts, all the essential constituents of a man's dietary are the products of the protoplasmic activity of other organisms. When we consider the almost universal distribution of man upon the face of the earth, and that the plants and animals which flourish in different regions vary to an enormous degree, it is clear that the races of mankind are able to exist upon dietaries which must differ widely from one another. The difference is, however, more apparent than real, for the animals and plants consumed all owe their value as food to the fact that they are composed of one or more of three substances, protein, fat and carbo-hydrate. So that the contrast between the diets of different peoples, though very obvious when we regard the source and the appearance of their food, is less marked if its actual composition be ascertained. Yet when this has been done, and the diets of various races have been expressed as containing on the average such and such proportions of the three main food-stuffs it will still be found that these proportions, as well as the total amounts of food taken, are far from identical. The variations are caused by numerous factors, such as the nature of the plants and animals available for food, and the degree of intelligence shown in securing a regular supply. The quality and sufficiency of the diet has, conversely, a far-reaching influence upon the development of the race, an influence which is directly seen in the physical well-being associated with an adequate supply of suitable food. The progress of any nation will be hampered if its citizens are ill fed, for upon food depends not only life itself, but the power to work and to resist disease. Further, the development of the race is indirectly affected by diet through the sharpening of the wits and the social co-ordination which arise in the course of evolution from the necessity for the provision of food. For the supply of food depends upon the exertions of the individual, and its regular distribution upon the organization of the race.

In this chapter we shall pass in review some of the experimental data upon which the science of dietetics is founded. In so doing we must not neglect the evidence already provided. In the experience of mankind we have spread before us the results of the experiment of ages. That experiment shows that the human race can live a healthy life under dietetic conditions of great variety. This single consideration indicates with what care conclusions should be drawn. Wisdom does not find her dwelling place exclusively in this or in that system. Only by a careful and open-minded examination of the teachings of experience, as well as of the results of scientific experiment, can principles be enunciated which will form a basis upon which dietaries may be constructed for the varying conditions of health and of disease.

The problems of dietetics are of great intricacy, for no definite food or combination of foods can be regarded as suitable for different people, or for the same person under different circumstances. The application of the experimental method has, however in this, as in other branches of science, yielded some insight into the general principles which govern the nutrition of the body.

Innumerable examples could be gathered from the vegetable and animal worlds to illustrate the great effect of food variations upon growth and development, of which we may quote two or three. Brennan's experiments show the influence of a nutritive soil upon the evolution of a plant. In 1872 that observer set some plants of Tradescantia Virginia in good soil and carefully tended them. The ovary of this flower is trimerous, there being three petals, three sepals and six stamens. In seven years a number of the blossoms showed five segments, and in fourteen years an ovary with eight segments was detected. On the other hand, a bad soil, as every farmer knows, will yield a poor growth. The dwarf plants of the Japanese have been produced in the course of time by keeping them in poor soil and pruning the roots. A good instance of the effect of under-nutrition upon the development of animals is furnished by de Varigny, who kept tadpoles in the gill-bearing stage for two years by withholding suitable food. When flesh was given the limbs were evolved in three weeks, the long tail gradually disappeared, and the tadpoles became toads at last. But perhaps the most striking example of the effect of food upon development in the animal world is afforded by the queen bee, which grows from a larva in all respects similar to that of the worker bee, but is differently treated in the one respect that it is assiduously fed upon a rich diet.

The state of nutrition may also influence the determination of sex, particularly in many of the lower organisms. Prantl observed that the spores of ferns developed chiefly prothallia, the male elements, if placed in a soil poor in nitrogenous material, especially if there was much crowding; with better soil and fewer spores, most of them were found to contain the female archegonia. Yung found that frogs fed upon meat produce a greater percentage of females. Many quadrupeds and birds multiply more freely upon a plentiful diet, although a change from a natural supply to an excess of food may have the opposite effect, and even produce sterility.

The nature of the food may modify the structure of the alimentary tract. John Hunter demonstrated, in a specimen preserved at the Royal College of Surgeons, that in a gull which had been fed for a year upon grain the muscular coat of the stomach became thickened. It has since been shown that in certain gulls this takes place annually; for half the year grain forms the dietary, and at this time the stomach wall takes on gizzard-like characters, whilst when the animal is feeding on fish these features disappear. It is not within our scope to discuss here the effects which changes of diet produce in the domestic animals, in the composition, for instance, of the wool of the sheep, of the flesh of the ox and pig, and in many other respects. The annals of institutes of experimental agriculture in this country, in Canada, the United States, and on the Continent, record a great number of such observations and abound in material of the greatest interest, to some of which we shall have occasion to refer.

Definition of food, and conditions which food-stuffs must satisfy.—A food has been defined by C. Voit as a "substance which can cause the addition of a necessary element to the body or prevent or diminish the discharge of such material." To this is added that the substance must not be injurious or cause a greater loss of energy than it brings in.

This definition includes oxygen, water and mineral salts, as well as protein, fat, and carbo-hydrate. It expresses the conception of food as matter supplied to the body, without verbal mention of the potential energy with which some of that matter must be endowed. Those foodstuffs which yield energy are, however, clearly designated in the words "substance which can . . . prevent or diminish the discharge of material" from the body. We have discussed the twofold function of the food in the last chapter and have seen that oxygen, water, salts, and that amount of protein which is needed to replace the wear and tear of tissues, supply the material needs of the body, whilst fat, carbo-hydrate and any excess of protein furnish energy for the activities of the muscles and other organs. It may seem unfortunate that the same term should be used for that which furnishes material and that which furnishes energy. But a separation of the two classes offers difficulties, for the energy yielding foods, especially protein, also provide material for the structure of the tissues, and any definition restricting the term food to substances capable of giving up energy to the organism would exclude water and salts, without which life cannot be supported. Oxygen is not commonly regarded as a food-stuff, and may be excluded by limiting the definition to materials taken in from the alimentary canal. We shall find occasion to discuss the part played by water and salts in the diet of man. The science of dietetics is, however, chiefly occupied with the study of those foods which are oxidized in the body and provide power for the activity of the muscles, glands, and other organs.

We have considered, in the previous chapter, the three classes of food-stuffs, protein, carbo-hydrate, and fat, and have referred to the decompositions which they undergo in the tissues. Each of them when oxidized by burning the dry material gives out a definite quantity of heat for every gramme burnt. This is known as the **heat value,** or **caloric value,** and is expressed in kilocalories. A kilocalorie, large calorie, or Calorie,[1] is a thousand small calories. A small calorie is the amount of heat required to raise a gramme of water through 1° Centigrade. This unit is inconveniently small for physiological values. The caloric value of any food can be determined by a calorimeter, and is a measure of the energy which is given

[1] When the word calorie is used alone it should, strictly speaking, be spelt with a capital letter if large calories are denoted. This rule is, however, commonly observed in the breach, and in works on metabolism the term calorie may always be presumed to refer to large or kilo-calories.

out by the complete oxidation of the substance under any circumstances. That is to say a gramme of fat oxidized in the body to carbon dioxide and water yields exactly the same energy, manifested as work or as heat, as if it were burnt in the calorimeter.

The following table gives the heat evolved by a few representative food-stuffs when burnt in a bomb calorimeter.

1	gramme of	casein . . .	yielded	5·9	kilocalories.
1	,,	egg albumen . .	,,	5·7	,,
1	,,	protein (average). .	,,	5·7	,,
1	,,	animal fat . . .	,,	9·5	,,
1	,,	butter fat . . .	,,	9·2	,,
1	,,	cane sugar . . .	,,	4·0	,,
1	,,	sugar of milk . .	,,	3·9	,,
1	,,	grape sugar . .	,,	3·7	,,
1	,,	starch . . .	,,	4·2	,,

(From Hammarsten's *Physiol. Chem.*, Transl. by Mandel.)

The carbo-hydrates and fats are completely burnt in the body, and therefore give up all their available energy. With protein the case is different, for the nitrogen it contains is excreted as urea and other bodies which are not completely oxidized and therefore have themselves a heat value. By subtracting the value of the nitrogenous excreta from that of the protein in the food a figure is reached which is a measure of the energy actually yielded to the body, and this is known as the "physiological heat value" of protein. Taking the average of the heat of combustion of different carbo-hydrates, fats, and proteins, and allowing for the incomplete oxidation of protein the physiological caloric values according to Rübner are—

1	gramme of	protein	= 4·1	calories.
1	,,	fat	= 9·3	,,
1	,,	carbo-hydrate	= 4·1	,,

On a vegetable diet the physiological heat value of protein is a little lower than the above, because absorption is less complete, and is given at 3·9. The value of animal protein is, however, about 4·2, so that on a diet of which 60 per cent of the protein was derived from animal sources and 40 from vegetable the figure would remain at that given by Rübner, namely 4·1.

From these figures it is possible to calculate approximately the fuel value of any diet if the composition of its constituents be known. A more accurate method is to determine in a calorimeter the heat of combustion of the actual foods and that of the dried excreta, the difference between the two giving the energy which the body has retained. This has been done in some recent researches. For calculating the value of diets in medical work, Rübner's averages are sufficiently accurate. We can therefore ascertain by these means how much energy is taken in by an individual over any period of time. This energy is used in the activities of the body or else stored up in fat, protein, or glycogen, to be available for use in the future. Careful experiments have shown that there is a balance between the energy taken in as food and that given out by the body in the form of work or heat, and that the body has no other source of energy but the food.

We see then that the food-stuffs, except water and salts, are substances which are capable of being oxidized to give up energy. But if this were all, any combustible substance, such as coal or wood, would be available as a food-stuff, and this is not the case. **A food** must therefore possess certain other qualifications. Of these the chief is that it **must be capable of digestion,** that is to say, of being broken down by the chemical activity of the digestive juices into such a form as can be absorbed, and further, the substances absorbed must be such as can be oxidized in the tissues.

In health the process of digestion is carried on without any conscious sensation except of well-being. In ill-health unpleasant sensations arise which we call indigestion. These feelings are almost always connected with that part of the digestion which takes place in the stomach. In a person of "weak digestion" a food may be indigestible in the sense that it gives rise to pain from the stomach, but may nevertheless be successfully dealt with by the juices of the small intestine, where the major part of digestion takes place. For this reason the term digestibility is often limited to mean digestibility in the stomach without undue delay or painful sensation, and the length of time which food remains in the stomach is taken as a measure of its "digestibility." This criterion is of use in disease but of much less value in health, and it is a mistake to conclude that foods which remain long in the stomach should be avoided by normal people on that account. In its true sense the term "digestibility" refers to the whole process of digestion, and an indigestible food is one a great part of which passes out in the fæces without having been disintegrated and absorbed. Most ordinary foods are in this sense digestible, the least so being vegetable foods containing much fibre. A table showing the digestibility or absorbability of a number of food-stuffs has been given in the last chapter under the heading of absorption.

The following table, representing the experiments of various authors and compiled from Hutchison's *Food, and the Principles of Dietetics*, gives the length of time which various foods were found to remain in the stomach.

Beef, raw	2 hours.
,, boiled	3 ,,
,, half roasted	3 ,,
,, roasted	4 ,,

The digestibility of mutton has been found to be about the same as that of beef. Pork requires a longer time than mutton and beef, and veal appears to occupy an intermediate position.

Bread, 2½ ozs.	2⅓ hours.
Eggs, two, lightly boiled	1¾ ,,
,, raw	2¼ ,,
,, poached with butter	2½ ,,
,, hard boiled	3 ,,
,, as an omelette	3 ,,
Fish, 7 ozs.	2½ ,,
Salt Fish	4 ,,
Apple, raw, 5⅓ ozs.	3⅙ ,,
Cabbage, 5⅓ ozs.	3 ,,
Cauliflower, 5⅓ ozs.	2¼ ,,
Potatoes, 5⅓ ozs.	2–2½ ,,
Lentils, boiled, 5⅓ ozs.	4 ,,
Peas, 7 ozs.	4¼ ,,
Rice, boiled, 2½ ozs.	3½ ,,

These figures must be regarded as examples and too much reliance must not be placed upon them. The time taken for dealing with a simple food-stuff does not necessarily apply to that food-stuff when taken with others. Individuals also differ widely in their digestive powers. We may expect the skiagraphic method to furnish us with exact information as to the length of time which meals remain in the normal and the diseased stomach.

COMPOSITION OF FOOD MATERIALS

The composition of the chief foods used in this country is given in the following tables. The foods are arranged in alphabetical order under the headings

These analyses are selected from Atwater & Bryant's *Composition of American Food Materials*, Bulletin 28, issued by the U.S. Department of Agriculture, from the Office of Experiment Stations. The caloric or fuel value of the foods, given in the last column of the tables, represents the "physiological" value, that is to say the available, not the total, energy.

CHEMICAL COMPOSITION OF FOOD MATERIALS.

In all cases the edible portion of the food is referred to.

Food Materials.	Water.	Protein. Nx6·25.	Fat.	Total Carbo-hydrates.	Ash.	Fuel value per pound.
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Cals.
ANIMAL FOOD.						
Beef, Fresh.						
Ribs, lean	71·3	19·5	8·3	—	1·0	715
„ medium fat . . .	62·7	18·5	18·0	—	1·0	1,105
„ fat	52·0	16·5	31·1	—	0·8	1,620
Loin, lean	67·0	19·7	12·7	—	1·0	900
„ medium fat . . .	60·6	18·5	20·2	—	1·0	1,190
„ fat	54·7	17·5	27·6	—	0·9	1,490
Round, medium fat . .	65·5	20·3	13·6	—	1·1	950
Sweetbreads as purchased.	70·9	16·8	12·1	—	1·6	825
Tongue	70·8	18·9	9·2	—	1·0	740

Food Materials.	Water.	Protein. Nx6·25.	Fat.	Total Carbo-hydrates.	Ash.	Fuel value per pound.
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Cals.
Animal Food, *continued.*						
Beef, Cooked.						
Roast	48·2	22·3	28·6	—	1·3	1,620
Loin steak, broiled	54·8	23·5	20·4	—	1·2	1,300
Beef, Corned.						
Corned beef	51·8	26·3	18·7	—	4·0	1,280
Tongue, whole	51·3	19·5	23·2	—	4·0	1,340
Veal, Fresh.						
Loin, medium fat	68·9	20·5	10·4	—	1·0	820
Liver	73·0	19·0	5·3	—	1·3	575
Lamb, Fresh.						
Forequarter	55·1	18·3	25·8	—	1·0	1,430
Lamb, Cooked.						
Chops, broiled	47·6	21·7	29·9	—	1·3	1,665
Mutton, Fresh.						
Leg, hind, medium fat	62·8	18·5	18·0	—	1·0	1,105
Shoulder, medium fat	61·9	17·7	19·9	—	0·9	1,170
Mutton, Cooked.						
Leg, roast	50·9	25·0	22·6	—	1·2	1,420
Sheep's kidneys, as purchased	78·7	16·5	3·2	—	1·3	440
Pork, Fresh.						
Ham, fresh	50·1	15·7	33·4	—	0·9	1,700
Loin chops	50·7	16·4	32·0	—	0·9	1,655
Pork.						
Liver	71·4	21·3	4·5	1·4	1·4	615
Pork, Salted and Smoked.						
Ham, smoked, medium fat	40·3	16·3	38·8	—	4·8	1,940
Bacon, smoked, lean	31·8	15·5	42·6	—	11·0	2,085
Bacon, smoked, medium fat	18·8	9·9	67·4	—	4·4	3,030
Bacon, smoked	20·2	10·5	64·8	—	5·1	2,930
Sausage.						
Pork	39·8	13·0	44·2	1·1	2·2	2,125
Poultry, Fresh.						
Chicken	74·8	21·5	2·5	—	1·1	505
Fowls	63·7	19·3	16·3	—	1·0	1,045
Goose, young	46·7	16·3	36·2	—	0·8	1,830
Turkey	55·5	21·1	22·9	—	1·0	1,360
Poultry and Game, Cooked.						
Capon	59·9	27·0	11·5	—	1·3	985
Turkey, roast	52·0	27·8	18·4	—	1·2	1,295
,, roast, light and dark meat and stuffing	65·0	(17·1[1])	10·8	5·5	1·6	870

[1] By difference.

Food Materials.	Water.	Protein. Nx.6·25	Fat.	Total Carbo-hydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD, *continued.*	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Cals.
Fish, Fresh.						
Cod	82·6	16·5	0·4	—	1·2	325
Eels, salt water, head, skin, and entrails removed	71·6	18·6	9·1	—	1·0	730
Hake, entrails removed	83·1	15·4	0·7	—	1·0	315
Haddock, entrails removed	81·7	17·2	0·3	—	1·2	335
Halibut, steaks or sections	75·4	18·6	5·2	—	1·0	565
Herring	72·5	19·5	7·1	—	1·5	660
Mackerel	73·4	18·7	7·1	—	1·2	645
Mullet	74·9	19·5	4·6	—	1·2	555
Salmon	64·6	22·0	12·8	—	1·4	950
Smelt	79·2	17·6	1·8	—	1·7	405
Trout, brook	77·8	19·2	2·1	—	1·2	445
Turbot	71·4	14·8	14·4	—	1·3	885
Fish, Preserved and Tinned.						
Haddock, smoked	72·5	23·3	0·2	—	3·6	440
Herring, smoked	34·6	36·9	15·8	—	13·2 chiefly NaCl.	1,355
Mackerel, salt, dressed	43·4	17·3	26·4	—	12·9 chiefly NaCl.	1,435
Salmon, tinned	63·5	21·8	12·1	—	2·6	915
Sardines, tinned	52·3	23·0	19·7	—	5·6	1,260
Shellfish, etc., Fresh.						
Crabs, whole	77·1	16·6	2·0	1·2	3·1	415
Crayfish, abdomen	81·2	16·0	0·5	1·0	1·3	340
Lobster, whole	79·2	16·4	1·8	0·4	2·2	390
Mussels, in shell	84·2	8·7	1·1	4·1	1·9	285
Oysters, in shell	86·9	6·2	1·2	3·7	2·0	235
Scallops	80·3	14·8	0·1	3·4	1·4	345
Turtle, green	79·8	19·8	0·5	—	1·2	390
Shellfish, etc., Tinned.						
Lobster	77·8	18·1	1·1	0·5	2·5	390
Eggs (Hen's).						
Uncooked	73·7	13·4	10·5	—	1·0	720
With shells	65·5	11·9	9·3	—	0·9	635
Boiled	73·2	13·2	12·0	—	0·8	765
White, boiled	86·2	12·3	0·2	—	0·6	250
Yolk, boiled	49·5	15·7	33·3	—	1·1	1,705
Dairy Products, etc.						
Butter	11·0	1·0	85·0	—	3·0	3,605
Cheese, American, pale	31·6	28·8	35·9	0·3	3·4	2,055
,, American, red	28·6	(29·6)[1]	38·3	—	3·5	2,165
,, Cheddar	27·4	27·7	36·8	4·1	4·0	2,145
,, Cheshire	37·1	26·9	30·7	0·9	4·4	1,810

[1] By difference.

Food Materials.	Water.	Protein. Nx6·25.	Fat.	Total Carbo-hydrates.	Ash.	Fuel value per pound.
ANIMAL FOOD, *continued.*	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Cals.
Dairy Products, etc., continued.						
Cheese, Dutch	35·2	(37·1)[1]	17·7	—	10·0	1,435
„ Limburger . . .	42·1	23·0	29·4	0·4	5·1	1,675
„ Roquefort . . .	39·3	22·6	29·5	1·8	6·8	1,700
„ Swiss	31·4	27·6	34·9	1·3	4·8	2,010
Milk, condensed, sweetened	26·9	8·8	8·3	54·1	1·9	1,520
„ whole	87·0	3·3	4·0	5·0	0·7	325
„ skimmed	90·5	3·4	0·3	5·1	0·7	170
Whey	93·0	1·0	0·3	5·0	0·7	125
Miscellaneous.						
Gelatin	13·6	91·4	0·1	—	2·1	1,705
Calf's-foot jelly	77·6	4·3	—	17·4	0·7	405
Lard, unrefined	4·8	2·2	94·0	—	0·1	4,010

CHEMICAL COMPOSITION OF FOOD MATERIALS.

Food Materials.	Water.	Protein.	Fat.	Total Carbo-hydrates including fibre.	Ash.	Fuel value per pound.
VEGETABLE FOOD.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Cals.
Flours, Meals, etc.						
Barley meal and flour . .	11·9	10·5	2·2	72·8	2·6	1,640
Barley, pearl	11·5	8·5	1·1	77·8	1·1	1,650
Corn flour	12·6	7·1	1·3	78·4	0·6	1,645
Hominy	11·8	8·3	0·6	79·0	0·3	1,650
Oatmeal	7·3	16·1	7·2	67·5	1·9	1,860
„ boiled	84·5	2·8	0·5	11·5	0·7	285
„ gruel	91·6	1·2	0·4	6·3	0·5	155
Rice	12·3	8·0	0·3	79·0	0·4	1,630
„ boiled	72·5	2·8	0·1	24·4	0·3	525
„ flaked	9·5	7·9	0·4	81·9	0·3	1,685
Wheat flour, California, fine	13·8	7·9	1·4	76·4	0·5	1,625
Wheat flour, entire wheat .	11·4	13·8	1·9	71·9	1·0	1,675
Wheat Preparations.						
Shredded	8·1	10·5	1·4	77·9	2·1	1,700
Macaroni	10·3	13·4	0·9	74·1	1·3	1,665
„ cooked . .	78·4	3·0	1·5	15·8	1·3	415
Vermicelli.	11·0	10·9	2·0	72·0	4·1	1,625

[1] By difference.

Food Materials.	Water.	Protein.	Fat.	Total Carbo-hydrates including fibre.	Ash.	Fuel value per pound.
VEGETABLE FOOD, *contd.*	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Cals.
Bread, Pastry, etc.						
Bread, Brown	43·6	5·4	1·8	47·1	2·1	1,050
Rolls, French	32·0	8·5	2·5	55·7	1·3	1,300
,, Vienna	31·7	8·5	2·2	56·5	1·1	1,300
White bread	35·3	9·2	1·3	53·1	1·1	1,215
Toasted bread	24·0	11·5	1·6	61·2	1·7	1,420
Gingerbread	18·8	5·8	9·0	63·5	2·9	1,670
Sponge cake	15·3	6·3	10·7	65·9	1·8	1,795
Lady fingers	15·0	8·8	5·0	70·6	0·6	1,685
Macaroons	12·3	6·5	15·2	65·2	0·8	1,975
Pie, apple	42·5	3·1	9·8	42·8	1·8	1,270
,, mince	41·3	5·8	12·3	38·1	2·5	1,335
Pudding, tapioca	64·5	3·3	3·2	28·2	0·8	720
Sugar, Starches, etc.						
Honey	18·2	0·4	—	81·2	0·2	1,520
Starch, arrowroot	2·3	—	—	97·5	0·2	1,815
,, sago	12·2	9·0	0·4	78·1	0·3	1,635
,, tapioca	11·4	0·4	0·1	88·0	0·1	1,650
Vegetables.						
Artichokes	79·5	2·6	0·2	16·7	1·0	365
Asparagus	94·0	1·8	0·2	3·3	0·7	105
Beets, fresh	87·5	1·6	0·1	9·7	1·1	215
Cabbage	91·5	1·6	0·3	5·6	1·0	145
Carrots, fresh	88·2	1·1	0·4	9·3	1·0	210
Cauliflower	92·3	1·8	0·5	4·7	0·7	140
Celery	94·5	1·1	0·1	3·3	1·0	85
Cucumbers	95·4	0·8	0·2	3·1	0·5	80
Leeks	91·8	1·2	0·5	5·8	0·7	150
Lentils, dried	8·4	25·7	1·0	59·2	5·7	1,620
Lettuce	94·7	1·2	0·3	2·9	0·9	90
Mushrooms	88·1	3·5	0·4	6·8	1·2	210
Onions, fresh	87·6	1·6	0·3	9·9	0·6	225
Parsnips	83·0	1·6	0·5	13·5	1·4	300
Peas, green	74·6	7·0	0·5	16·9	1·0	465
,, dried	9·5	24·6	1·0	62·0	2·9	1,655
Potatoes, raw	78·3	2·2	0·1	18·4	1·0	385
,, cooked, boiled	75·5	2·5	0·1	20·9	1·0	440
,, cooked, chips	2·2	6·8	39·8	46·7	4·5	2,675
,, cooked, mashed and creamed	75·1	2·6	3·0	17·8	1·5	505
Radishes	91·8	1·3	0·1	5·8	1·0	135
Rhubarb	94·4	0·6	0·7	3·6	0·7	105
Spinach, fresh	92·3	2·1	0·3	3·2	2·1	110
Tomatoes, fresh	94·3	0·9	0·4	3·9	0·5	105
Turnips	89·6	1·3	0·2	8·1	0·8	185

Food Materials.	Water.	Protein.	Fat.	Total Carbo-hydrates including fibre.	Ash.	Fuel value per pound.
VEGETABLE FOOD, *contd.*	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	Cals.
Vegetables, Tinned.						
Peas, green	85·3	3·6	0·2	9·8	1·1	255
Tomatoes	94·0	1·2	0·2	4·0	0·6	105
Pickles, Condiments, etc.						
Olives, green	58·0	1·1	27·6	11·6	1·7	1,400
,, ripe	64·7	1·7	25·9	4·3	3·4	1,205
Pickles, mixed	93·8	1·1	0·4	4·0	0·7	110
Fruits, Berries, etc., Fresh.						
Apples	84·6	0·4	0·5	14·2	0·3	290
Apricots	85·0	1·1	—	13·4	0·5	270
Bananas, yellow	75·3	1·3	0·6	22·0	0·8	460
Blackberries	86·3	1·3	1·0	10·9	0·5	270
Cherries	80·9	1·0	0·8	16·7	0·6	365
Cranberries	88·9	0·4	0·6	9·9	0·2	215
Currants	85·0	1·5	—	12·8	0·7	265
Figs, fresh	79·1	1·5	—	18·8	0·6	380
Grapes	77·4	1·3	1·6	19·2	0·5	450
Oranges	86·9	0·8	0·2	11·6	0·5	240
Pears	84·4	0·6	0·5	14·1	0·4	295
Pineapple	89·3	0·4	0·3	9·7	0·3	200
Plums	78·4	1·0	—	20·1	0·5	395
Strawberries	90·4	1·0	0·6	7·4	0·6	180
Watermelons	92·4	0·4	0·2	6·7	0·3	140
Fruits, Dried.						
Apples	28·1	1·6	2·2	66·1	2·0	1,350
Apricots	29·4	4·7	1·0	62·5	2·4	1,290
Currants, Zante	17·2	2·4	1·7	74·2	4·5	1,495
Dates	15·4	2·1	2·8	78·4	1·3	1,615
Figs	18·8	4·3	0·3	74·2	2·4	1,475
Prunes	22·3	2·1	—	73·3	2·3	1,400
Raisins	14·6	2·6	3·3	76·1	3·4	1,605
Peaches	88·1	0·7	0·1	10·8	0·3	220
Pears	81·1	0·3	0·3	18·0	0·3	355
Nuts.						
Almonds	4·8	21·0	54·9	17·3	2·0	3,030
Brazil nuts	5·3	17·0	66·8	7·0	3·9	3,265
Chestnuts, fresh	45·0	6·2	5·4	42·1	1·3	1,125
,, dried	5·9	10·7	7·0	74·2	2·2	1,875
Cocoanuts	14·1	5·7	50·6	27·9	1·7	2,760
Filberts	3·7	15·6	65·3	13·0	2·4	3,290
Walnuts, California	2·5	18·4	64·4	13·0	1·7	3,300
Miscellaneous.						
Chocolate	5·9	12·9	48·7	30·3	2·2	2,860
Cocoa	4·6	21·6	28·9	37·7	7·2	—

GRAPHIC REPRESENTATION OF DIETS

The greatest hindrance to the practical study of dietetics is the troublesome arithmetic which has to be done, to calculate the heat value and the composition of an ordinary meal. Even if a diet is to be only roughly estimated over any length of time the labour involved is almost prohibitive, unless precisely the same foods are taken, and any means of simplifying the prescribing of diets is therefore to be welcomed. Irving Fisher has suggested that food should be served in portions representing 100 calories or a multiple of this quantity. A table is subjoined (p. 125) in which the quantity of food corresponding to this value is given. It is well worth while for any medical man to weigh out the commonly used foods, according to the table, in order to see the amounts of each which are of equal food value. An impression gained in this way by the eye is more lasting than the memory of figures gathered from the printed page, and it will be found that when these helpings have been weighed out once or twice it is easy in future to give the approximate quantities and to serve foods at table in portions of 100, 200, or 300 calories. This method should prove of value in sanatoria and other institutions, and in treating patients in their homes whose diet it is necessary to control. In the third, fourth and fifth column of the table is stated how much of the 100 calories in each portion is furnished by protein or fat or carbohydrate. This proportion is represented graphically by Irving Fisher on a triangle (Fig. 1), one angle P, representing protein, another F, fat, and the third C, carbo-hydrate. A right angled triangle is employed for convenience instead of an equilateral one. A food the caloric value of which is entirely due to protein, such as the white of egg, would be represented by a dot on the point P; butter, the heat of combustion of which is all derived from fat would fall on the point F, and starch on the carbohydrate point C. Foods containing various proportions of these three food-stuffs may be represented by dots in the triangle; the more protein, for instance, a food contains, the nearer will the dot be to P, whilst a food containing no protein would be located upon the line CF. In marking the points it is only necessary to consider the proportion of two of the elements, say protein and fat. For instance, in bread we see from the table that 13 per cent of its caloric value is furnished by protein, and 6 per cent by fat. The point representing bread will therefore be placed 13 hundredths from the line CF to P, and 6 hundredths of the distance from CP to F, as shown in Fig. 1. If the lines CP and CF be divided into ten parts as in the figure it is easy to find this point.

We at once have a graphic representation of bread as a food

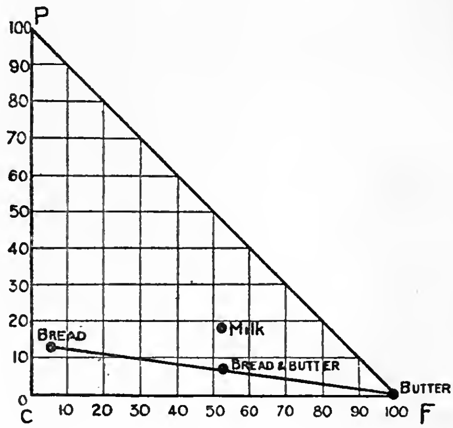

FIG. 1.

and can see at a glance that it is comparatively poor in protein and fat whilst rich in carbo-hydrate, as is evidenced by the nearness of the point to the angle C, or its distance from the line PF. In order to represent a mixed food such as bread and butter on the chart, we should mark in a dot for bread in the approximate place, representing 1·3 oz. of bread, or 100 calories; 100 calories in the form of butter would be ·4 oz., and this would be represented by a dot on the point F: a point halfway between the two will represent the composition of the bread and butter. If one portion of bread is combined with half a portion of butter the bread and butter point will be one-third of the way from the bread point to the butter point, it will in fact be at the centre of gravity of the two points supposing the bread point to be twice the weight of the butter point.

Milk is represented (Fig. 1) by a point above that of bread and butter since 52 per cent of its heat value is in the form of fat and 19 per cent as protein. In this way every food may be represented by a point on the triangle, and if each portion given be worth 100 calories, or a multiple of it, it is easy to find the point which will represent the meal as a whole.

Thus if, as in Fig. 2, the different points represent 300, 400 and 500 calorie portions respectively of three different foods, " the point representing the combination may be found by

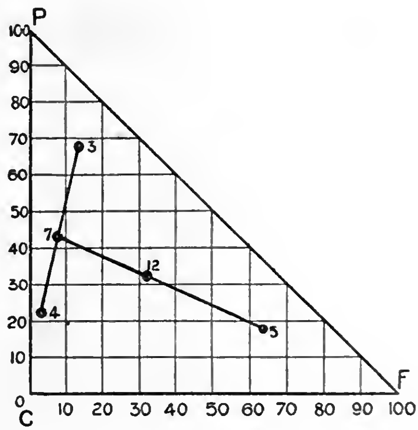

Fig. 2.

joining the points 3 and 4, and finding their centre of gravity, 7, situated nearer the point 4 than the point 3, and dividing the line between them in the ratio of 3 to 4. The first two points, 3 and 4, may be considered as concentrated at 7 with their combined weight, 7. We then find the centre of gravity of this new point 7 and the remaining point, 5. The centre of gravity of this point 7 and point 5 will be a point, 12, on the straight line between them, situated nearer the 7 than the 5, and dividing the distance between them in the ratio of 5 to 7. At the point 12 the whole combination of 12 portions may be considered to be concentrated. It is evident that we could find the centre of gravity of the same three points by combining them in a different order, but the result would be the same " (I. Fisher). This process when it has been once or twice practised is easy. The central point may also be found still more quickly by an arrangement by which a triangular card is pierced by heavy-headed pins representing the foods, pins of half or quarter the weight being used to represent half or a quarter of a standard portion. The card and pins are then hung in a mechanical device and adjust themselves in such a position that the centre of gravity lies beneath a pointer which can be pushed down to mark the spot. The caloric value of the diet is found by adding up the number of whole portions of 100 calories each.

The proportion of protein in the food, if 100 grammes be taken as a normal quantity, should be above the 10 line, for 100 grammes in a diet of 3,000 calories represents 13 per cent of the total calories. A diet suitably provided with protein will be somewhere in the rectangle represented in Fig. 3. The foods or diets lying within this rectangle are well balanced. Low protein diets will be on or below the lower boundary. As an illustration the positions of diets in the navy and army, and in prisons are shown.

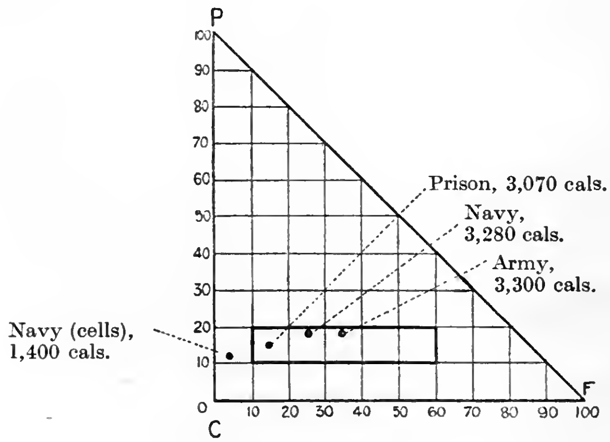

FIG. 3.

The following table gives the data necessary for serving diets which can be graphically represented by this method.

The Quantities of Ordinary Foods which yield 100 Calories with the Distribution of the Heat Value between Protein, Fat and Carbo-hydrate (Irving Fisher).

Food Materials.	Weight of Food yielding 100 Calories.		Percentage of total Caloric Value yielded by Protein, Fat or Carbo-hydrate.			
	Grms.	Ozs.	P.	F.	C.	
Cooked Meats.						
Chicken	90	3·2	79	21	—	Ordinary serving.
Beef, boiled, lean .	62	2·2	90	10	—	Large serving.
,, roast, fat . .	32	1·2	25	75	—	Small serving.
Sirloin	40	1·4	31	69	—	,, ,,
Mutton, boiled . .	34	1·2	35	65	—	,, ,,
Ham, boiled. . .	32	1·1	28	72	—	Ordinary serving.
,, ,, fat . .	27	1·0	19	81	—	Small serving.
Bacon	15	0·5	6	94	—	Ordinary serving.
Uncooked.						
Mackerel. . . .	57	2·0	50	50	—	Ordinary serving.
Oysters	100	3·6	10	1	89	One dozen.
Dairy Products.						
Milk	140	4·9	19	52	29	Small glass.
,, skimmed . .	255	9·4	37	7	56	1½ glass.
,, condensed, sweetened . . .	30	1·1	10	23	67	,,
Whey	360	13·0	15	10	75	2 glasses.
Butter	12·5	0·4	0·5	99·5	—	—
Cheese	22	0·8	25	73	2	1½ cubic inches.
Eggs	59	2·1	32	68	—	1 large egg.
Cream	49	1·7	5	87	8	—
Cereals, Vegetables, Nuts and Fruits.						
Bread, white . .	38	1·3	13	6	81	Thick slice.
,, brown . .	43	1·5	9	7	84	,, ,,
Wheat flour . . .	27	1	15	5	80	—
Rice	28	1	9	1	90	—
,, boiled . . .	87	3·1	10	1	89	Ordinary serving.
Cream rice pudding.	75	2·6	8	13	79	Small serving.
Tapioca, cooked .	108	3·8	1	1	98	Ordinary serving.
Potatoes, boiled .	102	3·6	11	1	88	1 large serving.
,, baked .	86	3	11	1	88	1 good sized serving.
Cabbage	310	11	20	8	72	—
Lettuce	505	18	25	14	61	—
Peas	178	6·3	25	3	72	2 servings.
Beans (tinned), baked	75	2·7	21	18	61	—
Chestnuts . . .	40	1·4	10	20	70	—
Brazil nuts . . .	14	0·5	10	86	4	3 nuts.
Almonds. . . .	15	0·5	13	77	10	8 almonds.
Dates (edible portion)	28	1	2	7	91	3 large dates.
Figs, dried . . .	31	1·1	5	—	95	1 large fig.
Prunes, dried . .	32	1·1	3	—	97	3 large prunes.
Raisins	31	1·1	3	9	88	—
Grapes	140	4·8	5	15	80	—
Bananas. . . .	100	3·5	5	5	90	1 large banana.
Apples	206	7·3	3	7	90	2 large apples.
,, baked . .	94	3·3	2	5	93	—
Apple pie . . .	38	1·3	5	32	63	⅓ ordinary serving.
Oranges	270	9·4	6	3	91	1 very large.
Water melon . .	760	27	6	6	88	—
Tomatoes . . .	430	15	15	16	69	4 ordinary size.
Marmalade . . .	28	1	0·5	2·5	97	3 teaspoonfuls.
Sugar.	24	0·9	—	—	100	1½ lumps.

In the following list, the more common foods are arranged in the order of their richness in potential energy.

COMMON FOODS IN ORDER OF THEIR CALORIC VALUE.

	Amount containing 100 Cals. in Ounces.		Amount containing 100 Cals. in Ounces.
Butter	0·4	Mackerel	2·0
Brazil nuts	0·5	Eggs	2·1
Bacon	0·5	Boiled rice	3·1
Cheese	0·8	Chicken	3·2
Sugar	0·9	Baked apples	3·3
Fat ham	1	Bananas	3·5
Beef or mutton with fat	1·2	Boiled potatoes	3·6
Bread	1·3	Milk	4·9
Cream	1·7	Apples (raw)	7·3

The following tables classify the common foods according as their energy is due to protein, carbo-hydrate or fat. It will be noticed that milk is the only food in the lists which contains a good proportion of all three. Cheese, Brazil nuts, and bread are represented in each list and contain a fair proportion of at least two of the food-stuffs.

COMMON FOODS ARRANGED IN ORDER ACCORDING TO THEIR VALUE IN PROTEIN, CARBO-HYDRATE AND FAT.

Percentage of Total Heat Value of Food furnished by its **PROTEIN.**		Percentage of Total Heat Value of Food furnished by its **FAT.**		Percentage of Total Heat Value of Food furnished by its **CARBO-HYDRATE.**	
	Per cent.		Per cent.		Per cent.
Lean beef (boiled)	90	Butter	99	Tapioca (cooked)	98
Chicken	79	Bacon	94	Prunes (dried)	97
Mackerel	50	Cream	87	Figs (dried)	95
Skim milk	37	Brazil nuts	86	Rice (boiled)	89
Eggs	32	Fat ham	81	Oysters	89
Beef with fat	25	Fat beef	75	Potatoes (boiled)	88
Cheese	25	Cheese	73	Bread	81
Fat ham	19	Eggs	68	Peas	72
Milk	19	Boiled mutton	65	Milk	29
Bread	13	Milk	52	Cream	8
Potatoes	11	Mackerel	50	Brazil nuts	4
Boiled rice	10	Chicken	21	Cheese	2
Brazil nuts	10	Boiled lean beef	10		
Bacon	6	Bread	6		
Cream	5	Bananas	5		
Bananas	5	Potatoes	1		
Butter	·5				

THE COST OF FOOD

The cost of food is of prime importance, both to families and to institutions. It should be considered in relation to the fuel value, and to the values in protein, rather than to the price per pound. Atwater's invaluable studies included an examination of this question, the results of which are embodied in tables and diagrams showing the amount of fuel value of each food constituent which could be purchased for 25 cents, about a shilling. The following tables (from Hutchison) show the purchasing value of a shilling for fuel and protein, applied to our ordinary food-stuffs.

QUANTITY OF FUEL VALUE OBTAINED FOR A SHILLING IN COMMON FOODS.

Bread,	at 1½*d.* per pound	. . . .	10,764 cals.
Peas,	,, 2*d.* ,, ,,	. . . .	8,921 ,,
Potatoes,	,, ½*d.* ,, ,,	. . . .	3,796 ,,
Milk,	,, 1½*d.* ,, pint	. . . .	3,000 ,,
Butter,	,, 1*s.* 3*d.* ,, pound	. . . .	2,884 ,,
Apples,	,, 1*d.* ,, ,,	. . . .	2,856 ,,
Cheese,	,, 6*d.* ,, ,,	. . . .	2,638 ,,
Fish,	,, 4*d.* ,, ,,	. . . .	953 ,,
Eggs,	,, 1*s.* ,, dozen	. . . .	839 ,,
Beef,	,, 9*d.* ,, pound	. . . .	829 ,,

QUANTITY OF PROTEIN OBTAINED FOR A SHILLING IN COMMON FOODS.

Peas . . .	572 grammes.	Milk . . .	114 grammes.
Bread . . .	283 ,,	Eggs . . .	79 ,,
Cheese . . .	272 ,,	Potatoes . .	54 ,,
Fish . . .	218 ,,	Apples . . .	27 ,,
Beef . . .	127 ,,	Butter . . .	3·5 ,,

It will be seen that bread holds the first place for fuel value and peas (dried) for protein.

THE EFFECT OF COOKING

Cooking sterilizes the food and renders it more palatable. It also alters its composition in various ways, according to the method employed.

The effect of cooking upon the composition of **meat** has been the subject of numerous researches. In a recent paper by Grindley and Emmet describing experiments under conditions which were carefully controlled, the following conclusions were drawn. Cooking has but little effect upon the total nutritive value of meat, whether it be roast or boiled. The method of cooking, however, influences the quantity of the nitrogenous and non-nitrogenous extractives, to which the flavour is chiefly due, for by boiling about two-thirds of these substances, on the average, together with a part of the salts of the meat, some fat and a very little protein, are transferred to the broth. The longer a piece of meat is boiled the richer is the broth, but even after many hours the amount of nutritive matter extracted is small. The larger the piece of meat the smaller is the relative loss. There is of course no economic disadvantage in boiling if the broth be served for soup. In raw meat about one-eighth of the protein is in a soluble form ; boiling converts most of this into insoluble protein. Whether the meat be put first into hot or cold water makes very little difference to its final composition.

In roasting, broiling, or cooking by any form of dry heat there is a slight loss of extractives and salts, but much less than with boiling, for it was found that dry-cooked meats contain twice as much of those soluble organic and inorganic flavouring substances as boiled meats. There is also a smaller loss of protein and fat in cooking meat by dry heat, but from the nutritive standpoint the difference is so slight that it is not of importance.

The cooking of **vegetables** breaks up starch grains and bursts the walls of the cells, enabling the digestive juices to penetrate the mass. The usual method, boiling, involves a great loss of nutritive material. Snyder, Frisby and Bryant have shown that with **potatoes** the loss is greatest when they are peeled and soaked in water before cooking, the shortage of total nitrogenous matter amounting, under these circumstances, to 50 per cent and of protein 25 per cent. The loss of mineral matter is 38 per cent. The loss of total nitrogenous matter and protein is about half the above if the peeled potatoes are put at once into boiling water : if they are boiled in the skins it is negligible. In boiling **carrots** about 40 per cent of the total nitrogen and 26 per cent of the sugar is lost, equal to about a pound of sugar in a bushel of carrots. At least a quarter of the nutritive material is therefore extracted. There is less waste if the carrot be in large pieces, and if the boiling be rapid and very little water be used. **Cabbage** does not contain much nutritive matter to begin with and it loses about a third of it in boiling. This loss is avoided if the cabbage be cooked with meat as a stew, the fluid part of which is also consumed. It is better to steam vegetables than to boil them. With cooking by dry heat these losses are obviated. Potatoes baked in their skins are therefore an economical food.

On the whole cooking renders meats slightly less digestible and vegetables more digestible.

THE CONSTRUCTION OF DIETS IN HEALTH

In constructing diets we have first to determine what amount of food is required for each individual in order that the body may be supplied with sufficient energy to keep it in health and vigour ; and secondly, to consider what the composition of that food should be.

I. The Amount of Food Needed.

Under this heading we shall refer to the total quantity of food, expressed in terms of its fuel value and independent of its constituents. The amount of food necessary to keep any person in a natural state of health and activity depends upon a number of circumstances. No definite rule can be laid down, for the energy required will of course depend upon how much is being used in keeping the body warm and in doing work. If more heat is lost and more work is being done, more food must be supplied, or the body would be obliged to use its own tissues and the weight would fall. The principle of the **conservation of energy** applies to the human being as it does to the rest of the natural world, animate and inanimate. We have no experimental evidence of exceptions to this rule, know of no subtle method by which one individual can, over any long period of time, do double the work of another upon half the food : although to the unconsidering eye this may sometimes seem to be the case, we shall see that many factors besides the actual external work, have to be taken into account in estimating the energy used by any person ; factors of build, of extent of surface, of restlessness or placidity when not actually working, of the skilled action of trained muscles or the energy wasting contractions of unaccustomed movements.

In the first place the food must be **proportional to the weight of the body.** Other things being equal big people will require more than those of smaller build. In comparing different individuals the weight must, therefore, be taken into account and this is done by speaking of the fuel value required for each unit of weight, expressed as calories per kilogramme. The average fuel value required by adults is about 40 calories per kilogramme, but it is possible to support existence upon much less than this ; on the other hand, under special circumstances, much more is required ; for instance, when weight is being laid on, or a great amount of work is being done, as much as 110 to 120 calories per kilogramme has been known to be taken.

Since the body cannot produce energy which is not derived from the oxidation of the food or of its own substance, it is clear that there is an irreducible minimum of food which is required if the body tissue is not to be used up. This may be regarded as about 35 calories per kilogramme for a person living a sedentary life ; 4½ pints of milk would furnish this amount of energy (1750 calories) for a person of 8 stone, or 1 lb. 2 oz. of bread and 8 oz. of meat. For an individual resting entirely in bed it may be as low as 25 calories per kilogramme, which would be given by 3 pints 2 oz. of milk, or by 5½ oz. of meat and 13 oz. of bread.

The **extent of surface** which the body presents has a considerable influence upon the quantity of food required. Thin and angular people have a very much greater surface relatively to their weight than those of rounded contour, and small people have a greater surface, relatively to their weight, than large. One of the main sources of loss of energy from the body is the radiation of heat from the skin, and this varies directly as the area of surface : a whale, for instance, is materially aided in keeping its temperature constant in icy waters by the fact that its surface is small compared to its bulk. Small mammals, having a relatively great surface, have a more active metabolism and require very much more food per kilogramme than large ones. As an illustration the following figures may be quoted, showing the amounts of urea excreted by a man, a dog, and a rabbit during fasting, when all the energy used is being supplied from the fat and protein of the body.

A fasting man	weighing	70	kilos	excreted	·6 g.	urea per kilogramme.
,, dog	,,	30	,,	,,	1·6 g.	,, ,, ,,
,, rabbit	,,	1	,,	,,	3·6 g.	,, ,, ,,

The amount of energy derived from the protein is six times as great for each unit of weight in the rabbit as in the man. A better way of estimating the metabolism is to measure the oxidation going on in the body as shown by the carbon dioxide excreted from the lungs. In dogs it has been shown that this is more proportional to the surface than to the body weight. Richet found that dogs varying in weight from 2·2 to 28 kilogrammes excreted the same amount of carbon dioxide per hour for each square centimetre of surface. Now the heat lost from the skin is automatically supplied by the generation of heat in the muscles, and the temperature thus kept constant. In anæsthesia this regulation fails and the temperature falls, since the loss of heat from the surface is no longer co-ordinated with its production in the muscles. Richet accordingly found that in dogs under the influence of chloral the excretion of carbon dioxide was no longer proportional to the surface of the animal but simply to its weight.

These considerations are of special interest in connexion with the feeding of premature and thin infants, who will require more food than plump ones, since a small thin child has a very large surface relatively to its weight. As it grows, and especially as it lays on fat and becomes rounded, the weight increases more rapidly than the surface. Accurately expressed the mass increases as the cube, the surface as the square. Various researches could be quoted to illustrate this point. The amount of milk taken at the breast can be ascertained by weighing the child before and after it is fed. This has been done over long periods, and at the same time analyses have been made to determine the heat value of the mother's milk. In this way it has been found that an ordinary new-born child, excluding the first week when it is losing weight, requires about 100 calories per kilogramme, whilst when the child is six months old it uses 80 or less, the lessened requirement being largely due to the diminution of surface relatively to bulk. The actual amount of milk taken by the older child is, of course, greater; we are here referring to the amount taken for each unit of weight. We may assume, therefore, that a child weighing 8–9 lb. should receive, after the first week or two, a minimum of 100 calories per kilogramme. In English measure this is equal to $2\frac{1}{4}$ oz. of cow's milk to each pound, or a pint for a child of 9 lb. For a child of six months the minimum of 80 calories per kilogramme is equivalent to $1\frac{3}{4}$ oz. of milk for each pound. Artificially fed children have been found to require in some instances more than this heat value if they are to grow at the usual rate. To illustrate the greater quantities required by thin children, Heubner's case may be quoted of a premature child receiving 110–125 calories per kilogramme which failed to increase in weight until it obtained 150 calories per kilogramme. This is equivalent to 68 calories, or about $3\frac{1}{3}$ oz. of cow's milk, to the pound. In an infant whose weight is stationary, the protein tissues continue to grow but the child loses fat. Although the chief reason why thin infants require more food per pound is the loss of heat from their greater surface, there is another factor, namely, the rate of growth; this is greater in the early months of life, but it will only account for a small proportion of the great metabolic activity at this time. If this be so, and the loss of heat from the surface be so great a drain upon the energy of the body in small animals, we should expect that a saving to the metabolism would be effected if the temperature of the external air were raised. This has been found to be the case. If a child be kept in an incubator the loss of heat from the surface is lessened, or entirely prevented, and it has often been possible to keep premature children alive in this way. The premature child, with its small bulk and relatively great surface, cannot deal with enough food to make up the loss of heat from its skin; but it can often assimilate enough for nutrition and growth if that loss be prevented.

Even in adults the extent of surface should be considered with the diet. Stout people have a relatively smaller surface than thin, and this is one reason why they often have a smaller appetite. Another reason is that fat is an inert tissue and is not undergoing active metabolism and does not need nourishing as do the active tissues. A fat man, therefore, having relatively a smaller amount of active tissue, and a smaller loss of heat from the surface than a thin man, requires less food for each pound of weight.

Growing animals naturally require more food to form the tissue which is being developed from day to day. We have already mentioned that the younger the animal the greater is the rapidity of growth. Heubner found that the rate of growth in a baby in the first three months of life was seven times that from the sixth to the ninth month. No weight is added unless the food supplied is above a certain amount, which is seldom less than 70 calories per kilogramme, or 1½ oz. of cow's milk to the pound per day, and is, as stated in the last section, usually much more. It is true that instances have been recorded in which infants have grown naturally with this supply, but they are uncommon. The excess of food above this figure must be greater than the weight to be put on, for the actual amounts of food retained each day form only a small proportion of the extra food taken.

In adults increasing in weight there is a definite limit to the amount which can be laid on daily, with the exception that after long periods of fasting and in convalescence from wasting diseases a more rapid increase may be for a time maintained.

Rest and activity.—In the ordinary life of adults the amount of food needed depends more closely upon the muscular activity than upon any other factor. Certain muscles are always active, such as those of the circulatory and respiratory apparatus; the tone of the voluntary muscles is being constantly maintained, except in sleep, and during digestion the muscles as well as the glands of the alimentary canal are working; all this work is usually designated as "internal work," and it is essential; a man lying in bed upon a minimum diet would expend the energy of his food upon the performance of these functions, and the heat manifested would be employed in maintaining his temperature. Individuals who are moving about in the ordinary course of life and employing their skeletal muscles naturally use more energy and require more food. Thus Atwater found in his admirable observations that a subject confined in the small calorimetric chamber, even when not doing any definite work, used 80 per cent more energy than when lying asleep; a demonstration in figures of the recuperative powers of sleep. Slight unnoticed movements are responsible for a considerable expenditure of energy; it has been found by Johannsen that by sitting perfectly still and controlling such movements the oxidation as measured by the carbon dioxide expired could be reduced by nearly a third. The taking of food itself causes a definite expenditure on the part of the glands and muscles of digestion. In a resting man it has been found that the excretion of carbon dioxide is over 20 per cent greater when food is taken than upon a fasting day. That this is due to gastric and intestinal activity is supported by the observation that a similar increase follows the administration of purgatives. A meal of protein is followed by a greater and more prolonged rise of oxidation than one of fat or carbo-hydrate, and this is in accordance with the fact that protein takes longer to digest.

A much greater increase in the oxidation processes is caused by the exercise of the voluntary muscles and is followed by a corresponding demand for more food. The relation of work to the diet of man is of great practical importance, and many experimental studies have been made upon it. We shall here discuss the subject so far as it bears upon the total amount of food, and shall have occasion later to consider the constituents of which this food should be composed. It is clear that unless the tissues are to be drawn upon additional energy must be furnished to supply that which is manifested as mechanical work. In Atwater's experiments a man working a stationary bicycle against resistance evolved as much as 1,000 calories in a couple of hours. The same subject working moderately hard evolved 500 calories in that time, and when resting in the night 150 only. The point of importance in fixing a dietary for stringent conditions, as for soldiers on active service, is to determine how much more food need be given. The following figures compiled from bulletins 98 (1901) and 149 (1904) issued from the Office of Experiment Stations of the United States Department of Agriculture, shows the heat value taken in the food by various men doing severe muscular work.

	Cals. per day.	Protein.	Fat.	Carbo-hydrate.
Brickmakers, New England	8,569	180	365	1,150
Lumbermen, Maine, U.S.A., working in winter and sometimes in cold water.	6,995	182	337	812
Football teams	6,590	226	354	634
Bicyclist (Albert) in six days' endurance contest	6,095	179	198	859
Bavarian lumbermen	6,015	130	292	724
Bicyclist (Miller) in six days' endurance contest (winner)	4,770	169	181	585
Rowing club	3,955	155	177	440
Ordinary standard for man with light to moderate work	3,050	112	—	—
Ordinary standard for man with sedentary occupation	2,700	100	—	

The amounts of food taken by some of these workers are enormous. We cannot, however, conclude that they are excessive unless the food were not absorbed, or the subjects were putting on weight, and neither in the Maine lumbermen nor in the bicyclists was this the case. These quantities are far in excess of those required by ordinary workmen, and they show strikingly how extraordinary demands must be met by extraordinary supplies. It is surprising that the bicyclists Albert and Miller, who rode for six days an average of 18½ and 20 hours respectively, did not take more food, but their nitrogen balance showed that there was a considerable daily loss of protein, and it is probable that their stores of body-fat were called upon. That the bicyclists and the rowing men should come low down on the list may be partly due to the fact that their work was done in spells, the body recuperating in between; it also suggests that the body may be able to act much more efficiently as a work producer when one definite series of muscular movements is repeated over and over again, as in bicycling or rowing. According to Atwater's experiments an ordinary individual doing muscular work does not yield more than about 20 per cent of the energy expended as actual work. That is to say, in working a bicycle 100 calories are expended in the body in order to get the mechanical equivalent of 20 calories of heat actually delivered on the pedal. The most economical oil engine yet devised is said to yield 33 per cent of its energy as work; ordinary good oil and steam engines have an efficiency of 15 to 22 per cent. Zuntz has concluded on experimental grounds that men, horses, and dogs have an efficiency of 35 per cent and Kellner and Wolff found the same for the horse, a figure much higher than Atwater's. It is clear that if by training the efficiency of a man could be increased from 20 per cent to a much higher figure he would need proportionally less food. This would be more likely to take place where only one series of movements was involved. The football team in the above series took much more food than the oarsmen or bicyclists. Success in rowing or bicycling depends on learning to use certain muscles so as to get the greatest possible mechanical advantage from the levers represented by the oar and the pedal, and upon being able to keep these muscles supplied with blood. In playing football, as in hard labouring employments, most of the muscles of the body are called upon and in various combination with other muscles, and in such a case we should not expect them to work with the same neatness and economy.

We may say then that experimental investigation in a calorimeter, and experience, teach that, as we should expect from the principle of the conservation of energy, the muscular work done by any individual cannot be increased over any long period without an increase of food, and that the amount of food added must always be very much greater than the heat equivalent of the actual work done. In ordinary individuals about one-fifth of the added food will be furnished as work, the rest being dissipated as heat; under special circumstances probably a greater efficiency may be attained. When work is carried on under adverse conditions of climate and is exhausting, so that tired muscles are called upon to contract, no doubt the efficiency is much lowered, and this is probably why such an extraordinary supply of food was consumed by the lumbermen. Whatever may be said later about the need for protein, there can be no question as to the greater caloric requirements of workers. This is recognized in the regulations for the army rations of various nations in peace and in war, as is shown in the following table. We must remember, however, that exposure to cold, as on active service, is an additional factor calling for an increase in the food supply. It will be seen that the peace ration is raised by at least 1,000 calories in war time.

CALORIC VALUE OF RATIONS.

	Peace.	War.
Great Britain—		
Regulation diet	2,946	3,987
[1] Actual diet obtained	3,319	
Germany	2,592	small 3,613
		large 4,213
France	2,310	small 3,079
		large 3,413

Revue de Science de l'Entendance Militaire, Aug., 1907, vol. 20.

We have seen above that the requirements of a moderately active man may be taken as 3,000 calories. The usual rations in the navy slightly exceed this. In severe weather, or on night duty, the value is raised to about 4,400 calories. It appears then that ordinary severe labour is met by the addition of about 1,000 calories to the diet. This amount is contained in ¾ lb. of bread and 2 oz. of meat, or in ½ lb. of bread and 3 oz. of cheese. When an extraordinary amount of work and endurance is required, the caloric value of the food must be further increased.

Effect of climate upon the amount of food required.—We have seen that in cold climates, owing to a greater loss of heat, more food will be necessary, other things being equal, than in the temperate zone, and in the temperate zone more than in the tropics. The difference, however, in civilized races under ordinary conditions is far less than might be expected, and this is because the heating of houses indoors and the thickness of the clothing out of doors is so arranged that most of the surface of the body is kept at about the same temperature, so that as Rübner has said, we all live in a temperature of about 90° Fahr., which is that of the air between the skin and the clothes. In very hot weather the appetite diminishes and less food is taken, but weight is often lost, showing that the needs of the body

[1] Calculated by Pembrey and Parker.

are not entirely met by the food. The performance of work needs the same supply of food in hot and cold climates. When the worker is so exposed to cold, or to wet and cold, that the clothes cannot prevent great loss of heat from the skin, then much more food will be required. This is a partial explanation of the large quantities of food, amounting to 7,000 calories, taken by the Maine lumbermen referred to on p. 135. In arctic regions those foods which have the greatest heat value, that is, the fats, are especially serviceable.

II. The Proportions of the Food-stuffs required in the Diet of Man.

We have seen that the common experience of mankind and the evidence of scientific inquiry agree that a sufficient amount of food must be taken daily to yield from 2,500 to 3,000 calories. When we come to inquire of what constituents this food should consist, we find a general agreement upon fundamental points, but a great deal of difference of opinion upon others. It is established that the dietary of man should include all three food-stuffs, protein, fat, and carbo-hydrate. The protein is essential : no other material can supply the loss involved in the wear and tear of living organs. No other food-stuff can entirely supply the needs of an animal as protein can those of the carnivora. In the case of man, a healthy existence cannot be supported upon protein without carbo-hydrate, and it is a great advantage to him to have fat in his diet as well, since fat gives a greater proportion of energy, weight for weight, than carbo-hydrate or protein. We have seen that protein furnishes material for the metabolism of structure, whilst carbo-hydrate and fat, and any protein in excess of that required for structure, furnish energy for the metabolism of function, or put in another way, fuel value to supply heat and work. Two points arise for consideration, first, what is the minimum amount of protein which is essential for existence, and secondly, what is the amount which is desirable in order to maintain the body in the highest degree of efficiency ? The first question we can answer upon the evidence before us, but there is considerable disagreement on the second. Provided that a certain minimum of protein be supplied, and sufficient caloric value, an active life can be supported upon very varying proportions of the three elements. This fact must be clearly borne in mind. Any experiments showing that men can live and work for long periods upon this diet or upon that, provided that the constituents satisfy the above fundamental condition, show us nothing new. Men have existed in the past, in the vicissitudes of wealth and poverty, freedom and captivity, upon dietaries as varied in both quantity and quality as will ever be designed by experimentalists. The main object of our inquiry must therefore be not to determine upon how much or how little a man can live, but what are the proportions of the food-stuffs upon which he can live with the greatest efficiency and economy.

The amount of protein.—The amount of protein regarded by Voit as a standard was 118 grammes, or just over 4 oz., for a man of 11 stone taking 2,800 calories a day. This is 1·7 grammes of protein per kilogramme. This figure, designated as Voit's standard, was arrived at by striking the average of a large number of observations, and may be taken to represent the diet chosen by a European of 11 stone doing a moderate amount of muscular work. Many people living sedentary lives take less both of protein and of caloric value, and of course those of smaller weight require a correspondingly smaller ration, other circumstances being equal. This may be illustrated by the following diet which was taken by a man just under 9 stone, and contains 90 grammes of protein, 67 of fat, and 385 of carbo-hydrate, total 2,300 calories :—

Bread, 19 oz. ; meat, 4 oz. ; potatoes, 8 oz. ; milk, a pint ; butter, 1 oz. : milk pudding, 4 oz. ; tea, 1 pint.

This is as liberal in protein as Voit's diet for an 11 stone man being 1·6 grammes to each kilogramme. The pint of milk could be replaced by 3 oz. of cheese, which would slightly raise the proportions of fat and protein. Those living more active lives and those of greater weight commonly take a larger proportion of protein as well as of caloric value. A diet of 3,500 calories and containing about 130 grammes of protein is given by :—

Bread, 16 oz. ; beef, 10 oz. ; potatoes, 16 oz. ; milk, a pint ; butter, 1 oz. ; oatmeal, 4 oz. ; sugar, 3 oz.

In all dietary studies which include any large number of people we find that the quantity of protein amounts to 100 grammes or more. It is seldom below 90 grammes per day for an adult.

The following table of diets, arranged in order of protein value, will illustrate this point.

COMPILED BY BENEDICT AND ATWATER FROM VARIOUS SOURCES

	Protein in Food.	Caloric Value of Food.
English weavers	151	3,475
Chinese laundrymen, United States	135	3,480
Tailor, England	131	3,053
Professor, Japan	123	2,343
Printer, United States	117	3,554
Physician, Germany	111	2,511
Students, men	110	3,496
Machinists, United States	102	3,470
Business men, United States	98	2,947
Students, Japan	94	2,712
Physicians, France	92	1,851
Students, women	85	2,696
Poor families in New York	75	2,087
Sewing girl, London, earning 3*s*. 9*d*. per week	53	1,820
Factory girl, Leipsic, earning 5*s*. per week	52	1,940

It appears from these figures that in Europe, Asia, and America those who are free to choose their diet choose such food as shall include about 100 grammes of protein. It is uncommon to find less than 90 grammes taken except in conditions of poverty. Foods containing protein such as meat, eggs, milk and cheese are dearer than foods which contain a greater proportion of carbohydrate such as bread, potatoes, rice, and macaroni, and accordingly in the lowest social strata we find that there is, perforce, a scarcity of protein. It has, however, been urged with considerable force and by some whose opinions are worthy of great attention that it is not necessary or desirable for man to take so large a quantity of protein as 100 grammes a day. This view is founded upon experimental considerations which we may now examine.

If a man receives a diet the caloric value of which is sufficient but which contains little or no protein, for instance, a diet of starch matter with cream, the excretion of nitrogen in his urine sinks to a low figure, even to 3 grammes a day. This nitrogen is in the form of urea, creatinin, uric acid and ammonia, with small quantities of other bodies, and may be regarded as representing the lowest possible level of nitrogenous metabolism resulting from wear and tear of tissue. The patient is not in nitrogenous equilibrium because little or no protein is being given. If from 30 to 40 grammes of protein (1 to 1½ oz.) be added to the diet, the caloric value being still made up by fat and carbo-hydrate, the individual can be kept in nitrogenous equilibrium excreting 4 to 5 grammes of nitrogen in the urine. If a further quantity of protein be given the nitrogen of this is excreted in the urine in a very short time. This does not necessarily mean that the extra protein has been used at once, but implies that the nitrogenous part of the protein molecule was not wanted and was therefore excreted rapidly. This nitrogen is turned out as urea; the residue of the extra protein is retained in the body for oxidation, and is referred to as the non-nitrogenous moiety. It is suggested as a deduction from these facts that 40 or 50 grammes of protein is all that is needed, and that when more is taken the rapid excretion of its nitrogen shows that it was in excess, and that its non-nitrogenous moiety is of no more advantage to the organism than fat or carbo-hydrate furnishing an equivalent amount of energy. These experiments were carried out by Folin. Many observations show that it is possible to live upon a diet containing only 40–50 grammes of protein. The following table from Jägerroos (*Skand. Arch. f. Physiol.* 13.375, 1902) summarizes a few of them.

Observer.	Weight.	Food.		Protein per Kilogramme.	Calories per Kilogramme.
	Kilos.	Nitrogen.	Protein.		
Hirschfeld	73	7·44	46	0·63	47
Kumagawa	48	8·25	55	1·14	54
Klemperer	64	5·28	33	0·52	28
,,	65·5	5·28	33	0·50	27
Peschel	74·5	5·88	37	0·49	46
Sivèn	58·9	4·52	28	0·48	41
Voit's standard	*70*	*18·9*	*118*	*1·7*	*40*

For short periods still greater reductions can be sustained, but since we know that a man can live for a few days on a diet containing no protein at all, this is of no importance to our present inquiry.

The most thorough series of experiments upon a low protein diet has been made by Chittenden, who showed that a number of men of varying occupations and social position were able to live efficiently and carry out their ordinary work on a diet containing about 50 grammes of protein per day, which is ·7 grammes per kilo for a man of 11 stone and ·9 for a man of 9 stone. These observations were made upon scientific men, soldiers working in a gymnasium, and students practising athletics. The latter were for five months in nitrogenous equilibrium upon a diet containing from 44 to 56 grammes of protein. Chittenden himself took remarkably small quantities of food and protein. One diet, for instance, consisted of :—

> Milk, 2½ oz. ; cream, 5 oz. ; sugar, 1 oz. ; biscuit, 3 oz. ; bread, 2¾ oz. ; butter, ⅓ oz. ; meat pie, 7¼ oz.

The conditions of the experiment must receive attention. The subjects were living quiet lives with regular work, sleep and food. The work was that to which they were accustomed and was performed at set times and rarely, if ever, to fatigue, and they were led to take a personal interest in the experiment. All these conditions, which apply also to most of the earlier experiments on this subject quoted above, are favourable to a minimal expenditure. Similar values have been found in a vegetarian married couple whose metabolism was investigated by Caspari and Glæssner. The protein in the food varied from 33 to 49 grammes per day. Hamill and Schryver found that a number of scientific men in London excreted about 9·6 grammes of nitrogen a day, equivalent to an intake of about 70 grammes of protein, a figure higher than those we have been dealing with, but lower than the Voit standard. Such results as these call for serious consideration. Voit set up a standard based upon experience gathered from those free to choose their own diet, of 1·4 to 1·7 grammes of protein to a kilogramme for an adult. The experiments detailed above give a standard of ·7 to ·9 grammes, roughly about half.

It is clear that on the one hand the theoretical reasoning from the fact that an excess of nitrogen is so rapidly eliminated from the body, and on the other the result of experiment, show that about 50 grammes of protein is sufficient to supply the needs of a man of average weight and to keep him in health for a considerable period of time. It is claimed by some, for instance, by Chittenden, that health is improved by such a diet, and the view has been put forward that a larger amount of protein is harmful, and involves the doing of an unnecessary amount of work by the kidney in excreting the extra nitrogen, and may cause disease. If this is so we ought to reduce by more than half the quantities of meat and eggs usually taken. The protein contained in the remainder and in the bread, puddings, and other foods would be ample to supply all our requirements. Such a course would also effect a considerable reduction in the cost of food.

No doubt a great many people eat meat to excess. That is, however, outside the question which is, is 100 grammes of protein per day, being that contained in a moderate English dietary, of benefit or the reverse?

In discussing this question we may first point out that it cannot be said to be proved that any benefit to health results from a low protein diet. Most physicians know some who have tried it and given it up, having thought after some months that they were less energetic than before, and were more liable to contract colds and other infections, and others who have convinced themselves that they are better on it, but have not convinced those who knew them on the old regime and on the new. Chittenden's subjects have many of them returned to an ordinary diet. This may be regarded by some as a backsliding, a moral delinquency, a yielding to the pleasures of the palate, but by others as evidence that a larger protein ration was more satisfactory to them. The influence of suggestion must also be borne in mind in considering the above figures. If a man knows that his nitrogenous metabolism is being investigated he is likely to unconsciously limit his protein food. The fact that most of the nitrogen of a liberal protein diet is rapidly eliminated is certainly of great interest, but cannot in the present state of our knowledge be said to prove that the protein which contained it was redundant. The suggestion that the excretion of this nitrogen is harmful to the healthy kidney is totally without foundation. Carnivorous animals live entirely on protein and fat, and no evidence has been produced to show that their kidneys suffer on this account. It has been said by Chittenden that the universal choice of a liberal protein diet by man cannot be taken as evidence that that food-stuff is beneficial in quantity any more than the very general taste for alcohol proves it to be a desirable food-stuff. This analogy is a false one. Alcohol, though physiologically capable of acting as a food-stuff, is not at all comparable to either protein, carbo-hydrate, or fat. Before it can be classed with them, it must be shown that a man or animal can exist for long periods of time, in health, while drawing a large proportion of his energy needs, say a third, from alcohol. This has been shown for protein innumerable times.

We may now consider some experiments on animals bearing on this question. Rosenheim, in 1891 and in 1893, found that dogs fed upon meat, fat and rice in which the proportion of meat, 2 grammes of protein per kilo with a total food value of 110 calories per kilo, was low for this animal, suffered from digestive disturbances, such as vomiting and poor appetite, which were relieved by giving meat, and from an incomplete absorption of the food, and, after several months, died in an apathetic condition. Bad results had previously been obtained by Munk in dogs fed upon a low protein diet. Hagemann also reported similar observations. Jägerroos believes that the deductions made from these experiments are not valid, and kept two bitches 6½ months upon a low protein diet without any disturbances of digestion. He states that 1·2 grammes of protein per kilogramme is sufficient quantity for these animals; dogs, as we have seen above, require more food per kilo than man, on account of their greater relative surface, and this must be allowed for in comparing the figures. Jägeroos' two bitches, however, succumbed rapidly to an acute infection contracted after the premature delivery of one of them, a fact which may have no bearing on the point at issue, but does not inspire confidence as to their power of resistance to disease. All these experiments on dogs are open to the criticism that the dog is a carnivorous animal and cannot be expected to do well on a diet so far removed from its natural habit. The pig, being like man omnivorous, is free from this objection. Benedict, in his valuable paper on this subject, quotes the following experiments. Shutt found that when the pig is fed upon Indian corn, which contains a low proportion of protein, the pork is of inferior quality, which is improved by the addition of skim milk, or beans. Pork butchers find that the intestines of hogs fed on low protein rations tear more easily when the carcass is dressed. A bad quality of pork is also produced if too much protein be given. Skinner also showed that in pigs a low protein diet of corn-meal caused impairment of the digestive capacity, especially if continued for a long time. The diet resulted in "poor appetites, light bone, deficient development in valuable portions of the carcass and a general state of unthrift, as shown by the hair, skin, and hungry look of the animals." The addition of a small amount of protein to the food resulted in a natural growth, and a healthy condition. In herbivorous animals, Benedict goes on to say, we should expect less marked effects, as they are accustomed to a low protein diet. Haecker, however, has found that cows do not thrive on a diet poor in protein. Ten cows were fed on their natural food and ten others on a diet containing less protein: for two years very little difference could be observed, but in the latter part of the third winter the second group of animals became thin and their coats harsh, and in two months it became necessary to increase the protein. These observations are not directly transferable to man, but are of considerable importance. Especially should it be marked that the effect of a low protein diet on pigs and cows was a very gradual one, but one which, nevertheless, led in time to a general deterioration of health. They do not give us information as to the level of daily protein intake suitable for a man, but they teach definitely, first, that in case of doubt it is better to be above that level than below it, and secondly, that experiments on man to be conclusive and show that men can live and work on a low protein diet as well as on the usual one, should last for several years, since in animals the reduction of

10

the protein in the diet below that to which they are accustomed is harmful, if continued over a sufficiently long period, which in the case of cows is two or three years.

The experiments upon man show that men can live in health for several months and do routine work on a diet containing about 50 grammes of protein per day, or half the usual quantity. It is not shown that this diet is advantageous, or that it would do no harm taken permanently.

We have now to consider whether as much **work** can be done **upon a low protein diet** as upon a more plentiful supply. We have seen that muscular activity involves the using up of energy, and that if the work of any given individual be increased, he will require more food. Should this extra food contain protein? Or will the addition of carbo-hydrate and fat meet all the needs of a man subjected to severe exertion? Physiological experiment has shown that when energy is used in the contraction of muscle there is not a corresponding breakdown of protein material, for the nitrogen in the urine is only increased to a slight extent. For example, one of Atwater's subjects did in a day external work equivalent to 543 calories. This would necessitate the using up of probably at least 2,000 calories. The excretion of nitrogen, however, was practically unaffected. The energy for this work was therefore furnished by the oxidation of non-nitrogenous material, presumably carbo-hydrate or fat. It would therefore appear that when severe work has to be done the addition of carbo-hydrate or fat is all that is necessary.

It is not safe, however, in the present condition of our knowledge, to take this as proven, for we are faced with the fact that those doing really heavy and continuous work are usually found to take a diet which not only is high in caloric value, but is also rich in protein. We are not now referring to feats of strength or athletic tests which may be done at the temporary expense of the tissues, which afterwards recuperate, or to such work as that of Chittenden's soldiers or athletes, whose every exertion would be followed by an appropriate rest, and whose muscles would arrive at a state of proficiency in which they may be supposed to work with a minimum of waste and damage to their cells; but to work such as that done by labourers, who are toiling daily to the point of fatigue and exercising various groups of muscles in all kinds of movements. The table already given on p. 135 shows the proportion of protein taken by such workers. These and other results are summarised by Benedict as follows :

Subjects.	Protein in Food.	Caloric Value.
People doing severe muscular work, lumbermen, etc.	175	5,500
People doing ordinary muscular work, carpenters, labourers, etc.	115	3,300
People doing light muscular work, business men, etc.	100	2,700

An interesting remark on this point is made by Darwin in *The Voyage of a Naturalist round the World.* He visited the Chilian copper mines, where at that time the ore was carried up a 450 foot shaft in loads of 200 lbs. at a time, by men who climbed up notched tree trunks placed zigzag in the sides of the shaft. The men were pale, and some of them with but little muscular development. They were fed on beans and bread, and themselves preferred bread which was in that country a luxury, but the masters, says Darwin, "finding that they cannot work so hard upon this, treat them like horses and make them eat the beans." In beans about 20 per cent of the energy is in the form of protein, in bread 9 to 13 per cent. Livingstone found in Central Africa that the grain-eating tribes could not endure fatigue so well as beef-eaters, who scorned "the idea of ever being tired." Carnivorous animals are capable of greater efforts and have more courage than the herbivorous. Irving Fisher, however, claims that a diet on the Chittenden scale is favourable to endurance, as measured by such actions as holding the arms horizontally as long as possible, or raising and lowering a dumb-bell. Observations were made upon nine students three times in the course of five months. During this time the protein was gradually reduced, but not so low as in Chittenden's experiments. The endurance was found to be much greater at the end than at the beginning of this period. The strength was, however, less, the grip of the right hand, for instance, being weaker at the end of the period in seven out of the nine men. No control experiments on other students are given. The loss of strength and loss of weight which these students suffered was attributed to overstudy, but the increase of endurance to the food. These considerations do not inspire confidence in the diet. Feats of endurance such as long walks have been done upon a vegetarian diet, but this is not necessarily deficient in protein. The great and undoubted increase in endurance as well as in mettle of a horse fed on beans or oats, as compared to one fed on grass or on hay seems to point to an opposite conclusion, namely that the increase of protein is beneficial to prolonged muscular exertion. Such horses can not only go more quickly, but can go much further than those on the low protein dietary, and horses fed on hay have more staying power if the hay have plenty of seed in it, which means more protein. Professor Dunstan, of the Wye Agricultural College, has kindly informed the writer that beans contain 23 per cent of digestible protein, oats 9 per cent, good hay (that is with plentiful seed in it) 7·4, and poor hay 3·4 per cent.

We may sum up the relation of protein to activity by saying that the bulk of the calorie value required for muscular work should be supplied by carbo-hydrate or fat, but that it is an advantage to also increase the protein in the food, and that a diet containing a fair amount of protein is likely to be favourable to an energetic existence. Since the actual energy for the contraction of muscle is supplied by non-nitrogenous material, we may suppose that a muscle can work more efficiently when the tissue lymph surrounding it is rich in protein molecules, or, again, the hypothesis may be put forward that it is an advantage to the body to have some of its non-nitrogenous oxidizable material derived from protein, the nitrogen of which may have been previously excreted.

We have considered the problem of the proportion of protein in the daily diet at some length on account of its great importance. The question must now be asked, Does a careful consideration of the experimental evidence lead to the conclusion that a reduction in this constituent of the food is desirable? Are the observations detailed above sufficiently convincing to justify us in regarding the consumption of protein by the average man as excessive or still more as harmful? It must be remembered that the dietetic habits of mankind are the result of a process which has been going on for ages; when, therefore, we find that both progressive nations and successful individuals take a fair proportion of protein, we must treat this fruit of accumulated experience with respect. The old idea that protein was the food *par excellence*, and that the more of it that was taken the better, has been succeeded by a more moderate and scientific view. In the opinion of the writer we shall be acting wrongly if we now go to the other extreme and adopt dietary standards in which the amount of protein is so low as to lie close to the physiological limit. Facts have been adduced above to show that such a course is not without danger to the individual and the nation.

A great **excess of protein** is not readily tolerated. A man cannot, as has been mentioned in a former chapter, exist in a natural state without a supply of carbo-hydrate in his food. The quantity of protein necessary to supply his caloric needs, if no other food be taken, is intolerable to the digestive system, and therefore a protein diet such as the Salisbury diet, is not exclusive of other foods for any length of time. Diaceturia and acetonuria occur, probably from the call on the body fat being so great that its oxidation is incomplete. The addition of fat to protein, without carbo-hydrate, will lessen the amount of protein required, but aggravates the acetonuria, whilst carbo-hydrate abolishes it. The amount of carbo-hydrate required is variable, but a small quantity, such as 70 grammes (2½ oz.), is insufficient if much fat is being taken (Rosenfeld). In a diet containing plenty of carbo-hydrate as well as fat, a large quantity of protein can be dealt with, especially if severe work is being done; as much, for instance, as 250 grammes a day has been found to be eaten by miners in Russia. Or in treatment by "forced feeding," in which small quantities of food are administered at frequent intervals, the amount may be as great. A patient observed by Hale White and the writer, took an average of 243 grammes for thirty-eight days, with a maximum of 292 grammes in a day. In diabetes still greater quantities are consumed in the effort to meet the caloric needs of the body, which is partially or completely unable to utilize carbo-hydrate. To the rule that protein and fat alone cannot maintain man in health without carbo-hydrate, there appears to be an exception in the case of dwellers in arctic regions who have became accustomed to such a diet. These are all extraordinary conditions. In ordinary life excess in the consumption of protein is harmful and leads to digestive disorders, as we should expect from the experimental evidence : it is also regarded as leading to arterio-sclerosis and chronic nephritis, though it is not often easy to dissociate this factor from others such as alcohol and bacillary toxins. In diseases of the kidney and liver, organs especially associated with the metabolism of nitrogen, it is obvious that particular care should be taken to avoid excess of protein. We may apply the results of the above-mentioned observations upon low protein to such cases, and prescribe a diet which shall include about 50 grammes of protein (contained, for instance, in 2½ pints of milk) ; care must be taken, however, that the caloric value of the food is made up with carbo-hydrate and fat. In acute nephritis a diet containing no protein may be given for three or four days.

The form in which protein is taken is of importance. Experience shows that it is not advantageous to take more than about half the protein ration in the form of meat, and this applies with special force to those living sedentary lives.

The amount of carbo-hydrate and fat.—In a diet of 2,800 calories per day, if 410 calories be furnished by 100 grammes of protein there remain 2,390 to be supplied by carbo-hydrate or fat, or both. 583 grammes of carbo-hydrate, or 257 of fat, would give this value. The proportion in which the two elements enter into the daily food is usually determined by the amount of fat which can be used. This may depend upon how much fat can be procured, for it is dearer than carbo-hydrate, or, supposing expense is not a matter of importance, upon how much can be borne by the digestive system. In ordinary dietaries we find that the fat varies between 50 and 100 grammes ; 100 grammes of fat will supply 930 calories which, with 410 from protein, makes 1,340, leaving 1,460, which would be supplied by 356 of carbo-hydrate. In adults it does not seem of great importance whether there is much fat or not, provided that the heat value of the food is maintained. The most recent work shows that fat and carbo-hydrate are about equal in value, calorie for calorie, as protein sparers. If there is any difference it is in favour of carbo-hydrate. The advantage of a fair quantity of fat is that of its small bulk, since 1 gramme of it is equal in food value to 2·27 grammes of carbo-hydrate. The ease with which a considerable quantity of food can be introduced into the body in such forms as butter, bacon, dripping and cream should always be borne in mind in prescribing a diet for a convalescent patient who is not putting on weight satisfactorily. Under special circumstances much larger quantities of fat than 100 grammes may be taken, for instance, with severe labour 365 grammes (with 1,150 of carbo-hydrate) (see the table on p. 135). In forced feeding, in the diet under the writer's observation mentioned above, an average of 250 grammes of fat per day was taken for 38 days, with a maximum of 311 grammes in one day. In children, fat cannot be entirely replaced by carbo-hydrate without harm resulting. The maldevelopment of rickets is by many believed to be chiefly due to a deficiency of fat in the food. Whether or not this is the main factor, it is certain that great improvement follows the administration of fat in the form of good milk, cod liver oil or dripping.

The table on p. 126 shows the forms in which fat and carbo-hydrate are taken in ordinary foods.

STANDARD DIETS

The consideration of the principles upon which diets are constructed has led us to the following proportions of food-stuffs for a man of 11 stone of moderate activity :—

Protein	100 grammes	equals	410	calories.
Fat	100 ,,	,,	930	,,
Carbo-hydrate. . . .	360 ,,	,,	1,480	,,
Total heat value equals			2,820	,,

In this 14 per cent of the heat value is derived from protein, 33 per cent from fat, and 53 per cent from carbo-hydrate. It supplies 40 calories and 1·4 grammes of protein per kilogramme.

1. This is almost exactly given by :—

> Bread, 1 lb. ; meat, 4 oz. ; eggs, 4 oz. (two small ones) ; cheese, 2 oz. ; potatoes, 1 lb. ; butter (or other fat), 2 oz. ; milk, ¼ pint ; sugar, ½ oz. ; tea, coffee.

which works out to—Protein, 99 ; fat, 97 ; carbo-hydrate, 362.

2. For a man or woman of 9½ stone an adequate supply would be :—

> Bread, 12 oz. ; meat, 6 oz. ; potatoes, ½ lb. ; butter, 1 oz. ; milk, 1¼ pints ; sugar, 1 oz. ; milk pudding, 8 oz. ; soup, a pint.

This is the "ordinary" diet at St. George's Hospital, and contains :

> Protein, 90 ; fat, 75 ; carbo-hydrate, 330 ; calories, 2,400 ;

giving 40 calories and 1·5 grammes of protein per kilogramme.

3. A similar diet actually taken by a man of 9 stone has been given above and may be repeated here.

> Bread, 19 oz. ; meat, 4 oz. ; potatoes, 8 oz. ; butter, 1 oz. ; milk, 1 pint ; milk pudding, 4 oz. ; tea, a pint.

This contains :

> Protein, 90 ; fat, 67 ; carbo-hydrate, 385 ; calories, 2,300 ;

and gives 40 calories and 1·6 grammes of protein per kilogramme.

4. The following diet was that taken by the French soldiers in the trenches during the siege of Paris (1870–71) (Gautier).

> Bread, 9 oz. ; meat, 6¼ oz. ; rice, 2¾ oz. ; biscuit, 9 oz. ; fat, ¾ oz. ; coffee, 2 oz. ; sugar, 1½ oz. ; wine and brandy equivalent to 3⅓ oz. of carbo-hydrate.

This contains :

> Protein, 83 ; fat, 32 ; carbo-hydrate, 457 ; calories, 2,510 ;

and gives for a man of 10 stone 40 calories and 1·5 grammes of protein per kilogramme.

This diet, owing to the scarcity of food, was lower in protein and fat than that taken by hard workers, and finds its place among the diets for sedentary occupations. The soldiers suffered a little from hunger, but were generally in good health, although the winter was a cold one.

The diets of those doing muscular work show a considerable increase, especially in protein. We may take as an example the ordinary diet in the French Army in order to compare it with the last example.

> Bread, 1 lb. 10 oz., or biscuit bread, 1 lb. 9 oz.; or biscuit, 1 lb. 5 oz.; meat, 14 oz., or preserved meat, 7 oz.; dried vegetables or rice, 2 oz.; lard, 1 oz.; sugar, ¾ oz.; coffee, ½ oz.; salt, ¾ oz.

This contains:

> Protein, 129; fat, 69; carbo-hydrate, 440; calories, 2,956.

For a man of 10 stone this is 46 calories and 2 grammes of protein per kilogramme. For a man of 11 stone the figures are 42 and 1·8 respectively.

5. Ration of the British Army in the Crimea (from Gautier).

> Bread, 24 oz.; meat, 17 oz.; rice, 2 oz.; sugar, 2 oz.; coffee, 1 oz.; tea, ¼ oz.; rum, the equivalent of ½ oz. of carbo-hydrate, lemon juice, salt and pepper.

This contains:

> Protein, 154; fat, 31; carbo-hydrate, 457; calories, 2,793;

and for a man of 11 stone gives 40 calories and 2·2 grammes of protein per kilogramme. This ration was much lower in caloric value than is desirable for men undergoing severe exertion, and was especially deficient in fat.

The caloric value of modern war rations is much greater and has already been given on p. 137.

Various dietary studies of workmen doing moderately severe work have given the following results:

	Protein.	Fat.	Carbo-hydrate	Calories	Author.
English labourer	184	71	570	3,655	Smith & Playfair
,, blacksmith	176	71	666	4,007	Playfair
German farm labourer	143	108	788	4,696	Ranke
French farm labourer	149	79	830	4,560	Gautier

Some studies of the diet of those doing especially severe work have already been referred to on p. 135.

In conclusion, we may adopt Atwater's standards as embodying the results of modern investigations into the diet of adults.

	Protein.	Calories.
Woman with light muscular exercise	90	2,400
Woman with moderate muscular work	100	2,700
Man without muscular work	100	2,700
Man with light muscular work	112	3,000
Man with moderate muscular work	125	3,500
Man with hard muscular work	150	4,500

CERTAIN CONDITIONS WHICH INFLUENCE THE DIET

Childhood and youth.—The large amount of food required by infants relatively to their weight has been referred to above in the section dealing with the relation between diet and the extent of surface and rate of growth and some of the experimental data discussed. The proportions of the three food elements which are required may be taken to be those which are provided by nature in the mother's milk.

As the infant grows into the child, although the rate of growth becomes less, there is a much greater expenditure of energy in the muscles owing to the constant activity of a child, and the supply of food per kilogramme requires to be kept at about the same level. A boy of four weighing 2 stone 4 lb., just recovered from a slight surgical operation, who was kept in the hospital for a time, and whose food was weighed, was found to be taking 121 calories per kilogramme, which was made up as follows:

> Bread, 8 oz.; butter, 1 oz.; eggs, 6 oz. (3 small eggs); milk, a pint; cream, 1 oz.; milk pudding, 8 oz.; jam, 1 oz.

This contains:

> Protein, 63; fat, 72; carbo-hydrate, 202; calories, 1,757;

and gives 4·3 grammes of protein per kilogramme.

A boy suffering from amyotonia congenita of nearly the same age and weight took a similar diet containing 110 calories and 4 grammes of protein per kilogramme. In this case muscular activity was almost at a minimum, but the boy was very thin, and a plentiful diet would be required to make up for the loss of heat from his relatively greater surface.

The amount of protein per kilogramme is much greater than is taken by adults, but it is difficult to compare the figures, and it is clearer to express the percentage of the total heat value of the diet which is derived from protein ; this is 15 per cent in each of these boys, which is a little above the proportion of protein in our standard diet for adults. About 40 per cent of the total heat value was furnished by fat. It would be obviously unwise at a period of rapid growth to limit the protein and, as a general rule, it may be said that the proportion both of protein and fat in the food of children should be kept up.

Children of school age again take a high proportion of calories. The writer is indebted to the Governor of the Duke of York's Royal Military School and to Major Dyke for particulars of the food taken by 540 boys in that school for a week. The average age was 12½ years ; the boys were weighed during the period, and their average weight was 5 stone 4·85 lb. The time of year was June. In this week the food supplied was equivalent to 94 calories per kilogramme ; 13 per cent of the total energy was derived from protein, and about 8 per cent from fat. The ration is therefore a liberal one, but would be improved by a larger proportion of fat.

Mr. C. H. S. Frankau, F.R.C.S., has kindly furnished particulars of the dietary of an orphan school near London. The food taken by 401 children of the average age of 11 years and 10 months, of whom 260 were boys and 141 girls, amounted to 2,300 calories for each child per day. If the average weight be assumed to be about 5 stone, this is equivalent to 73 calories per kilogramme. The quantity of food is therefore less than is provided in the Duke of York's School. Probably the children in the latter school take more exercise, especially as they are all boys. The proportion of the total energy derived from protein, 15 per cent, is about the same, whilst that from fat, 23 per cent, is higher than in the Duke of York's school.

In general terms it has been calculated that a child about

8 years old requires half the food of an adult, and that a child of 16 years old will eat nearly, or quite as much, as an adult of ordinary weight and of sedentary occupation.

Influence of sex.—It is not certain that sex has any direct influence upon the amount of food needed. Women require less than men because they are commonly smaller, have a larger proportion of fat than the average man, and usually do less muscular work. When these points have been allowed for, there does not seem to be much difference. In a healthy woman in bed in hospital awaiting an operation the amount of food taken, reckoned as calories per kilogramme, was about the same as in men under similar circumstances. The diet in pregnancy should be liberal, but need not be excessive. It has been calculated that the average daily deposition of material in the fœtus during the last three months of pregnancy is not more than about 3 grammes of protein and 3½ of fat, with ·7 grammes of salts. Material is also required for the development of the uterus and mammæ; and there is often a general deposition of fat at this time, to be called on later to meet the demands of lactation. The oxidation processes are increased during pregnancy because the weight is increasing; the excretion of carbodioxide per kilogramme remains at the same level.

Observations on animals show that the loss of protein in parturition is often greater than the gain during pregnancy: that is to say, the mother does not store as much protein from the food as is laid down in the fœtus and, therefore, supplies some to the fœtus from her own tissues. This was not invariably the case, however, and it is possible for the mother with a sufficient supply of suitable food to assimilate and retain sufficient protein for the fœtus without any drain upon her own tissues. During and after delivery there is a considerable loss of protein, but with a rich diet nitrogenous equilibrium may be attained towards the end of the first week of the puerperium.

During lactation from 500 to 1,000 calories is given out from the body daily in the form of milk, and an equivalent amount of food should be added to the ordinary diet. It has been shown in animals that the mother may retain sufficient protein from the food to make up that lost in the milk. The diet should include abundance of protein and fat.

Training.—It is probable that the question of diet in training has been considerably over-discussed. Certain it is that diet will not produce muscular efficiency, whereas regular graduated exercise upon an ordinary sufficient diet may do so. The constant practising of any series of movements such as running, walking, rowing, or bicycling is likely in itself to lead to a more economical performance of the mechanical work involved, so that the store of energy available will last a longer time. The heart and circulation are of prime importance, for the smooth working of a muscle is dependent upon the removal of waste products by the blood, and upon the regular absorption of sufficient oxygen and elimination of carbon dioxide by the lungs. The enforced rests, the regular meals, and the general discipline of a period of training is also of very great value in bringing the neuromuscular system into a perfectly healthy condition. The diet in training must be an easily digested one, for indigestion in any form is fatal to success. This is one reason why a large amount of protein is preferred by athletes. Carbo-hydrate foods are often bulky, though not necessarily so, and fatty foods in excess are liable to be borne badly by the stomach. It appears also from the most recent work that protein is not converted into fat, and one object of the athlete is to have as little fat in his body as possible. The amount of food should always be increased: this is found to be so in dietary studies on training, with the exception of those of Chittenden, and according to Benedict, the athletes observed by Chittenden have returned to their former and more usual diet. We have already considered the relation of food to muscular work, and have given on p. 135 the diets taken by football men, rowing men, and professional bicyclists.

A number of experimental studies (Mosso, Harley) has shown that sugar is of great value when muscular exertion is severe. Locke has demonstrated the beneficial effect which dextrose has upon the perfused heart; when it is added to the perfusing solution the force of contraction is favourably influenced within a few seconds. In training, sugar should be freely taken, either dissolved in fluids such as cocoa, or in such a form as chocolate.

During the performance of prolonged feats of muscular exertion the diet should be such as to call for a minimum of digestive work on the part of the alimentary canal ; fluid, easily assimilable foods will be readily absorbed and rapidly available for use. In his six days' ride, the bicyclist Miller, referred to on page 135, took his food in the form of eggs, milk, meat extract, boiled rice, boiled oatmeal, Charlotte russe, custard pie, tomato soup, sugar, apples and oranges, with a little bread on one day.

Intellectual work has not been found to have any demonstrable quantitative effect upon the metabolism of man : the energy of cerebral activity is not measurable by the most accurate calorimetric methods. A man doing hard mental work in Atwater's respiration chamber gave the same results as when he was resting. Neither has mental activity been found in health to produce any qualitative change in the metabolism. The diet of such workers does not, therefore, need special consideration in this chapter.

In advanced age the amount of food required is less than in the more active years of life. Various studies of the metabolism in old people have shown a food value of 21–38 calories per kilogramme (von Noorden). The proportion of protein varied from ·7 to 2 grammes per kilogramme. The diet should be simple, and of a nature which can be properly masticated ; and the less digestible foods should be avoided.

WATER

The body is made up of about 60 per cent of water, about 20 per cent of fat, and 40 per cent of dry substances. Water is, therefore, an essential constituent, and must be constantly supplied to replace that which is being lost. The chemical changes taking place in the tissues are reactions between dissociated molecules in a weak saline solution. Hence any considerable drying of the body would arrest all vital processes. When a man is deprived of food he is able to live for a considerable period upon his own tissues; this is not the case with water, total deprivation of which can only be survived for a short time. Atwater and Benedict found that, upon an ordinary diet, an individual not doing muscular work took on an average about 4 pints of water a day in a 49 days' experiment; this includes that taken in the solid food as well as in liquids.

The elimination of water takes place in the urine and fæces, and from the skin and lungs. The tissues retain approximately the same quantity in health, so that with a sufficient supply the amount of water lost is determined by the amount taken in: if enough water is not available to make up the minimal loss thirst arises. Variations in the loss of water are chiefly due to evaporation from the skin, for this is the means by which any excess of heat is dissipated, and the temperature kept constant. The amount of water in the urine, if the diet be the same, will vary inversely as the loss from the skin, and therefore in hot weather the urine is scanty, and in winter abundant. The total loss of water from all sources is rather more than the quantity taken in the food, for the oxidation of the hydrogen of the solid food produces a half pint or more which must be eliminated. The average quantity evaporated from the skin and lungs in a day is about a pint and a half, two-thirds of which is given off from the skin; this total increases very much with active movement and may be over half a pint in an hour, i.e. ten times as much as is lost in that time during rest. The fluid taken must therefore be greater when much work is being performed; thus, in an individual working daily for 66 days the average intake of fluid (including that in the solid food) was found to be six and a half pints. The drinking of an increased quantity of water does not, apart from muscular exertion, lead to a greater evaporation from the skin, but the extra quantity appears in the urine, that is to say, other things being equal, water has a direct diuretic action. The evaporation from the skin is determined during rest by the needs of the regulation of heat and not by the amount of water taken in.

The amount of water vapour in the atmosphere has an important bearing upon the loss of water from the skin and lungs, for it is obvious that in moist air evaporation is hindered or suppressed, and the loss of heat from the skin therefore limited. This might cause a rise of temperature, and must be remembered in prescribing a steam kettle for a febrile patient, especially upon a damp day.

The nature of the diet has a considerable influence upon the amount of water passed out in the urine. If much protein is contained in the food the quantity of water excreted is increased and correspondingly more must be drunk. This is because the nitrogen of the protein is excreted in the urine in the form of urea, uric acid, and other bodies, and it involves less work to the kidney for these bodies to be passed out in a weak solution. On the contrary, a diet which is poor in protein will involve but little excretion of nitrogen, and the amount of urine will be considerably diminished. This may be exemplified by the following case. A patient in bed under the care of the writer, taking a mixed diet containing about 15 grammes of nitrogen, passed out 1,100–1,200 c.c. of urine a day. When placed upon a diet containing practically no protein, the quantity of urine sank on the first day to 530 c.c., and on the second day to 350 c.c. and on the three following days was about 500 c.c. On a vegetarian diet containing but little nitrogenous food less water will therefore be required than upon a diet containing plenty of meat.

We may now consider what experimental evidence we have as to the effect of an increase or diminution of the amount of water supplied in health and in disease.

The drinking of a large quantity of water by an ordinary man, not doing excessive work or living in a tropical climate, leads, as we have seen, to a considerable increase in the quantity of urine. This urine will be of low specific gravity, that is to say, the greater flow of water from the kidney is not accompanied by a corresponding excretion of solids. There is, however, some increase, for the total amount of nitrogen in the urine is raised. The amount of extra nitrogen in one day rarely exceeds 1 gramme, and in a number of careful experiments has not been found to be greater than 2·8 grammes. After a day or two, or at most a few days, the excretion of nitrogen returns to its ordinary level. Neumann found that about 6 grammes of nitrogen could be washed out in 9 days, but on returning to an ordinary quantity of fluid nitrogen was rapidly retained equivalent to that which had been eliminated. It appears, therefore, that although the flushing of the body with a large quantity of water washes out temporarily a certain limited amount of nitrogenous matter, the metabolism of protein on the whole is unaffected. The drinking of much water does not affect the oxidation processes of the body, as shown by the excretion of carbon dioxide. The same is true of waters containing small quantities of salts. Hence the statements made in the advertisements of various watering places that their waters increase metabolism is not supported by exact observation.

In **fevers** water should be supplied freely, with the object of replacing that in the perspiration or with the hope of promoting that secretion if it is deficient. Matzkevich observed a number of patients with typhoid fever to whom large quantities of water were given for four days at a time. During this period the amount of nitrogen in the urine was slightly increased, but not more than we have seen is the case in normal people. The copious draughts did not appear to have any influence on the temperature, pulse, or respiration. Gruzdiev also found an increase in the nitrogen in the urine when much water was drunk, in some cases amounting to several grammes. His experiments, again, only lasted four or five days at a time, and do not show whether it would be possible to continue to wash out nitrogenous material from the tissues in fever if the treatment were persisted in. Sollmann and Hoffmann's results indicate that the effect would fail after a few days as it does in health. They gave patients with typhoid fever 4 oz. of distilled water every quarter of an hour for a great part of the day, the average for the twenty-four hours being nearly 9 pints, and found that the excretion of nitrogen and of chlorides was unaffected; sweating was favoured, but the treatment was without obvious influence on the progress of the disease. In fevers there is reason to believe that bacterial toxins cause a breakdown of protein, and a good supply of water may assist in the elimination of these products. It is not, however, proved that there is any advantage in supplying such quantities of fluid as were given in these cases amounting sometimes to 10 pints in a day. In phthisis and pneumonia, Gruzdiev found only a slight increase in the nitrogen of the urine when much water was given, similar to that which occurs in health. In all the above experiments, the absorption of food was improved rather than diminished.

The **restriction of fluid** is often used as a therapeutic means, especially in aneurism, nephritis, heart disease and obesity. In health, if fluid is entirely withdrawn, the body receives only that contained in the solid food, about four-fifths of a pint, and that derived from the oxidation of the hydrogen of the food or tissues, about half a pint; the total may reach a pint and a half. The evaporation of water from the skin is controlled but that from the lungs goes on; the quantity of urine falls to half a pint or less; but in spite of the restriction of the loss of water from the skin and the kidneys, the total output is greater than the intake, and water is lost from the body. In "cures" by deprivation of water the tissue fluids are reduced by 6 to 8 per cent, and the blood serum has been found to lose over 10 per cent of its water. If the reduction became greater than this, we should expect harm to follow, for in animals a loss of much over 10 per cent of the total water is incompatible with health. In such restriction cures the appetite is lessened: the absorption of food is normal. The oxidation processes as shown by the respiratory exchange are not affected; nor, in animals, is the amount of fat in the body reduced. The experimental evidence is therefore against the statement that the oxidation of fat is favoured by the restriction of water. In obesity cures with limitation of fluid the reduction in weight is largely due to the loss of water. There is, however, also a loss of nitrogen in the urine, and this may persist for a time after the intake of fluid is increased again to the normal. We may sum up by saying that the restriction of fluid causes a diminution in the total water in the body, with a corresponding "thickening" of the body fluids, a lessening of the appetite, and a loss of protein.

The quantity of water which should be allowed in **nephritis** requires careful consideration, and has been the subject of many experiments. Dropsy may be due either to an inability of the kidney to pass out water, or to the retention of water by the tissues; in kidney diseases the blood appears to contain an excess of non-protein nitrogenous and saline molecules, and, supposing the same to be the case in the tissues, water would be retained by osmotic attraction in greater quantity than normal.

In acute nephritis drinking much water does not usually lead to diuresis, and the quantity taken should therefore be limited to that necessary to satisfy thirst.

In **parenchymatous nephritis** experiments show varying results corresponding, no doubt, to different types of the disease. It has sometimes been found that an increase in the fluid is followed by a similar increase in the urine: in such cases it may be assumed that it is advisable not to restrict fluid. If, on the other hand, the quantity of urine is unaffected, any extra water taken in is likely, in the absence of free sweating, to increase œdema.

In cases of **chronic granular kidney** there is usually a free secretion of urine. Bradford, and Ribbert, found the same to occur when the kidney substance was artificially reduced. We may regard this natural diuresis as advantageous to the kidney, for less work is involved in passing out the solids of the urine in a weak solution than in a strong one, and this being so it is undesirable to restrict fluid in this form of the disease. v. Noorden believes that the large amount of fluid dealt with is harmful to the circulation, and he limits the intake of water on this account. Dealing with much greater quantities of fluid does not, however, affect the circulation in diabetes, and it is probably more important to bear in mind the tendency to the accumulation of the non-protein nitrogenous and saline molecules in the blood in nephritis. We have already seen that restriction of fluid, unless very moderate, is likely to lead to a still greater increase in the solids of the blood and tissues, and that in animals there is a very definite limit to the degree of concentration which can be sustained without harm. This appears to be an indication that whenever the kidney can excrete water it should be encouraged to do so, with the object of washing out this material. Such a conclusion is supported by the observations of Frey, that in diuresis produced by water, the osmotic concentration of the urine may sink below that of the blood. This would greatly favour excretion by the kidney. The estimation of the molecular bodies in the tissues and blood in nephritis offers considerable difficulties, which are not, however, insurmountable, and it is desirable that a larger number of analyses should be made.

In the **dropsy of heart disease** the blood appears to be more watery than normal, but regains its proper composition when compensation is re-established. Although in circulatory failure the excretion of water from the kidney is diminished, this is not the cause of the œdema, which must be looked for in the conditions obtaining in the vessels of the affected tissues. Changes in the capillary walls probably have an important influence, especially in the peripheral parts of the circulation, for, the blood tending to stagnate in these regions, its oxygen is soon used up and the cells lining the capillary walls become insufficiently nourished, and fail to regulate the passage of both fluids and solids from blood to tissues and vice versa. It must be remembered that water is constantly being produced in the tissues, and it is only necessary to suppose that this water is not taken up by the blood vessels in order to explain the production of œdema. With an improvement in the heart's action, œdema is relieved from both sides; the abnormally high venous blood pressure sinks to its proper level, whilst on the arterial side the pressure rises and the circulation through the kidney is increased. We should not expect these conditions to be closely related to the amount of water taken in heart-disease, and in experiments dealing with the supply of water it is often difficult to separate the results of the restriction of that supply from those of other treatment employed at the same time, such as rest and digitalis. The cause of the whole condition is the failure of the heart, and treatment must be directed primarily to that organ. The restriction of water will do no good of itself. Experiment shows that a moderate limitation aids the heart, but, according to Minkowski, it should be very gradually carried out, 2½ pints being prescribed at first and reduced by a small amount daily, but not below a pint and a half. Thirst is lessened if no salt be allowed.

In the treatment of **aneurism**, the restriction of fluid is intended to be carried to such a degree that the blood becomes inspissated. We have seen that the water in the blood may be reduced by as much as 10 per cent, but that any greater reduction than this is attended with risk. The sensation of thirst may usually be taken as a guide. Most patients will not suffer extreme deprivation for long, but in the case of a very determined subject the danger of causing an increase in the breakdown of body tissues and of general failure must be kept in mind.

MINERAL SUBSTANCES

A great deal of attention has been paid by experimentalists to the metabolism of inorganic salts. With the exception of the part played by sodium chloride in the causation of some forms of œdema, it cannot be said that clinical medicine has been enriched to any great extent by the enormous number of researches made on this subject. The effect of added salts upon the metabolism of the body as a whole is negligible. The foods commonly taken in this country contain a sufficiency of salts. The beneficial effects of the various and much vaunted mineral waters upon metabolism, effects which have often been supported by imperfect metabolic experiments, are mainly due to the regular life, judicious diet, and graduated exercise enforced at the establishments where these water cures are carried out, and to the relief of constipation.

The body contains 100–140 grammes of **sodium chloride,** the proportion being greater in the blood than in the tissues; this amount varies little in most diseases, and about half of the osmotic pressure of the blood is due to it. Probably not more than 3 or 4 grammes a day are needed, but the quantity taken in the food is generally much greater than this. If it be reduced, the secretion of salt in the urine will fall until equilibrium is established at a lower level. If no salt be taken, chlorides will still be excreted in the urine, so that there will be a loss from the tissues, which may amount to 15 per cent of the total amount in the body. When salt is again added to the food, this quantity is quickly regained. Constant vomiting or repeated washing out of the stomach may lead to a considerable loss of chloride in the form of the hydrochloric acid of the gastric juice. The restriction of salt in man leads to a loss of weight because the chlorides which continue to be passed out are accompanied by water. In this way the deprivation of salt may be said to cause diuresis. Large doses of salt produce diuresis directly, in health, because the flow of blood through the kidney is increased and salt is excreted together with water; the tissues also contain more water, for the salt in them holds water by osmotic attraction. The quantity of water excreted in the urine is, however, greater than that retained by the tissues.

In many cases of **nephritis**, the kidney does not excrete salt so easily as in health. A normal man will pass out any excess of salt in a day or two, but a nephritic may not do so for several days. This behaviour of the kidney is, however, not constant: the excretory powers for salt, as for water and nitrogen, vary from time to time, and for this reason observations only extending over a few days may give unreliable results. Failure to excrete salt is most marked in acute nephritis and in severe cases of parenchymatous nephritis. In granular kidney the excretion may be normal, except during an exacerbation or when the heart is failing.

Although we usually speak of the excretion of the chlorides, it is the base, sodium, which is retained, at all events in many cases, whilst potassium may be passed out. Herringham made observations upon cases of nephritis in which the sodium and the potassium were estimated in the food, the urine and the fæces. In a girl aged 17, suffering from severe parenchymatous nephritis, the following total figures were obtained in a nine days' experiment:

	Potassium.	Sodium.
In food	13 grammes	5 grammes
In urine and fæces . .	13 ,,	2·4 ,,

On three days no sodium at all was excreted. The patient died about a month later. Similar analyses carried out in a man aged 47 in the last stages of interstitial nephritis with a dilated hypertrophied heart gave in four days,

	Potassium.	Sodium.
In food	10·2 grammes	6 grammes
In urine and fæces . .	13 ,,	0 ,,

This retention of sodium, as several workers have noted, is commonly, but not necessarily, associated with œdema. On the other hand, when œdema is present there is frequently a retention of salt. Widal and Javal and others have found that diminishing the salt in the food in nephritis lessens the œdema, and adding salt increases it. Herringham found this to be the case also in ascites, and demonstrated the presence of a considerable quantity of sodium in the fluid. Cantineau found in a case of tuberculous peritonitis with effusion that a salt free diet was followed by the disappearance of the fluid, whilst at a later period, when at the patient's wish salt was added to the diet, the œdema and ascites recurred. Achard has used the diet in the ascites of cirrhosis. Whether the retention of salt is secondary to that of water or the converse is a disputed point. According to Bainbridge, in some cases at least, the retention of salt is primary. But, whether or no either view is correct to the exclusion of the other, experiment shows that in dropsy from renal disease, and from many other causes, and even in severe cases of nephritis without dropsy, the salt in the diet should be restricted. Œdema is lessened because salt continues to pass out in the urine and draws water with it. A limitation of salt is safer and less open to objection than a restriction of water. The amount may be reduced to 2 or 3 grammes. Milk contains about a gramme to a pint. Ordinary bread contains 5–7 grammes to the pound, and, on this account, bread must be specially baked without salt. Meat, fresh-water fish, most vegetables, eggs, butter and sweets are allowed, with not more than 3 pints of fluid.

Carducci does not recommend a salt free diet in cardiac dropsy, though others report good results. In mild cases of chronic granular kidney without œdema it is not necessary to reduce the salt in the food.

Lime is an important mineral constituent of the food. Chossat showed in 1842 that pigeons fed upon a diet poor in lime suffered from disarrangement of the feathers, diarrhœa and thirst, and died in 8–10 months with soft bones. Subsequent experiments with a lime free diet have confirmed this result. Voit, Seemann, and Baginsky found that dogs fed upon flesh, fat and distilled water, appeared to be normal for a considerable time and increased in weight, but ultimately became weak and suffered from changes in the bones accompanied by a disappearance of inorganic material. In zoological gardens it has been found impossible to rear lion cubs until bone dust has been added to their dietary, in imitation of the natural state of carnivorous animals in which the bones are eaten with the meat. In some recent experiments by Chalmers Watson, changes in the bones have been described as the result of feeding rats upon a meat diet; the present writer has put forward the suggestion that these may be due, not to the meat as such, but to the fact that the diet is deficient in inorganic material, and has found that the general condition of rats fed upon meat is improved by the addition of a small quantity of calcium phosphate to the food. The amount of calcium absorbed from the alimentary canal is very small and is practically all deposited in the bones: human muscle only contains ·01 grammes per cent (Katz). Experiments which have been made to determine the part played by calcium in rickets have not led to very definite conclusions. When there is digestive disturbance it has been found that less calcium is absorbed. Arndt found that calcium was less freely absorbed from boiled milk than from unboiled. The bones in rickets are deficient in calcium, but it is stated that the tissues are not, whereas in animals upon a lime free diet, both bones and tissues show a diminution. Calcium lessens the muscular activity of the intestinal tract, as was experimentally shown by MacCallum. This explains the well-known fact that hard water is liable to produce constipation.

The metabolism of **phosphates** has been supposed to be specially connected with that of nervous tissues, but up to the present experiment has shown little foundation for this conjecture. Mental work has no influence upon the excretion of phosphoric acid. Folin and Shaffer showed that in cyclic insanity the phosphates in the urine were increased during the attacks. Beddard and the writer have found (in an unpublished research) that in migraine there is an increased excretion of phosphates in the urine in the early part of the attack. This increase is, however, rapidly followed by a corresponding diminution, so that the total amount excreted is not influenced. Ordinary food contains a sufficient proportion of phosphates, and no evidence has been brought forward that the addition of more is of any advantage to the organism.

GENERAL REMARKS ON NUTRITION IN DISEASE, INCLUDING FEBRILE CONDITIONS

Before considering in detail the effect of disease upon the nutritional needs of the body, it may be premised that a consideration of experimental work on this subject shows that, on the whole, the energy exchanges of the body follow the same rules in disease as in health. Diseases seldom exercise a direct influence upon the oxidation processes. Magnus Levy, in a paper published in 1906, has ably reviewed this subject. The most marked exceptions to the above statement are found, on the one hand, in myxœdema, in which the respiratory exchange may be reduced to half its normal value, and on the other in exophthalmic goitre, in which the oxidation is increased by 40–80 per cent, a fact which amply explains the wasting so often seen in patients suffering from the latter disease, and indicates that a rich diet should be prescribed. Even in these two cases the effect of the absence or the excess of the thyroid secretion is probably, in part at least, exerted indirectly, through muscular movement. In leuchæmia oxidation is increased, and in fevers, though seldom more than 20 per cent; and in the last stage of exhaustion from any cause the energy exchange is naturally lessened. In diabetes, gout, obesity, syphilis, tuberculosis and cancer the oxidation, in the absence of marked fever, is normal. Alimentary diseases affect the exchange of energy only by causing less food to be taken. Diseases of the heart, lung, kidney, and skin also have no specific effect on metabolism. In all these conditions, therefore, the food requirements will be influenced only indirectly. If a disease enforces rest less food is needed. If, on the other hand, it is accompanied by an increase of muscular action, as in the respiratory movements of dyspnœa or the restlessness of some fevers, this leads to a greater use of energy. Again, when the body suffers a loss of material, as in severe hæmorrhage, this requires to be made up. Magnus Levy, in the paper already referred to, points out that we cannot expect drugs or other therapeutic measures to affect metabolism in any subtle way, and must look for the beneficial action of medicines to be brought about by their influence upon the ordinary physiological processes which make up the activities of the body. For instance, by allaying restlessness, improving appetite, conserving the heat of the body or promoting the loss of heat, and so on. The only drug which seems to directly affect the oxidation processes is thyroid extract when given in myxœdema. On normal people its effect is far less marked. Such physical agencies as sunlight, air, cold water all work indirectly through the nervous, muscular and other systems of the body.

FEVERS

Many experiments have been made in man and animals to gain information as to the actual disturbances of metabolism in fevers and to determine how recovery may be aided by diet.

Fevers are commonly due to bacterial toxins. These produce a disturbance of the regulation of heat, of which the most marked feature seems to be a diminution of the loss of heat from the skin. In many cases there is an increased production of heat, but it is much less in degree than was formerly thought.

The amount of oxygen used is not commonly raised more than 10–20 per cent, and some authorities regard this increase as due solely to muscular activity, evidenced in the restlessness of a feverish patient. The excretion of nitrogen in the urine is much greater than is normal for a healthy person fed upon a similar diet, and this is due to the breakdown of protein tissues. This breakdown appears to be, in some cases at all events, independent of the increase of oxidation, and in some degree independent of the temperature, for it may occur in septic infections when there is no rise of temperature. Artificial pyrexia does, however, produce both increased oxidation and protein breakdown. The destruction of protein is considered to take place chiefly in the muscles because potassium salts, neutral sulphur and creatinine, which are regarded as derived from muscle, are also passed out in greater quantity. The writer has published some evidence to show that uric acid is probably chiefly derived from non-muscular protein tissues: if this be also true in pyrexia, we may conclude that all the protein tissues share in the disintegration, for the uric acid excretion is greater in fever.

With these considerations in mind we may now look at the experiments upon diet in febrile conditions. In the first place, it has been shown that animals suffering from fever cannot endure deprivation of food so well as normal animals. This seems obvious enough, but strikes directly against the old practice of putting fever patients on as low a diet as possible, and shows that food should be supplied in fever so far as is compatible with the condition of the patient. The idea has been current that the food taken in fever is not properly utilized, but analyses of the fæces show that the absorption of protein, fat, and carbo-hydrate does not materially differ from that in health: various experimenters have found this in typhoid fever, pneumonia, tuberculosis, recurrent fever and diphtheria. It might be thought that carbo-hydrate and fat, although not appearing in the fæces, are broken up in the intestines by bacterial action, and their energy lost to the tissues, but this has not been shown to be the case. On the contrary, it has been proved that it is possible to supply sufficient food in fevers to prevent a loss of weight in some cases and to greatly diminish the loss in others. The heat value should amount, if possible, to about 25 calories per kilogramme, a quantity sufficient to maintain the weight of a resting person. Three pints of milk, containing 1,150 calories, would be adequate for a person of 46 kilogrammes or 7¼ stone, and is therefore less than should be supplied to persons of greater weight. Milk should form the basis of the diet, because it appears that it is digested with the least expenditure of energy on the part of the intestines, but it should be thickened by the addition of other foods.

Protein may be added to the milk in the form of plasmon or some similar product, or given as meat juice, or minced meat, or pounded fish. Experiment has shown that the loss of nitrogen from the body is much less when a fair quantity of protein is taken, but it has not been found possible in pneumonia or typhoid fever to attain nitrogenous equilibrium. It is, however, an advantage to supply protein freely, and Moraczewski, who observed the metabolism in eighteen cases of pneumonia, believes that convalescence is thereby shortened. Puritz came to the same conclusion as the results of his experiments on cases of enteric fever.

Fat is a valuable constituent of the food, but requires to be given with caution, since an excess so readily excites disgust, and hinders the patient from taking a sufficiency of other foods. Milk fat is easily absorbed, and as much cream and butter as possible should be taken. The cream may be given in soups or added to the milk. Butter may be taken on bread, in puddings, and with a little potatoes. Two ounces of butter and ¼ pint of cream will add 750 calories to the daily ration.

Carbo-hydrate must necessarily form part of the febrile diet. It has been shown, both in animals and in man, that dextrose saves protein from being broken down in fever, as it does in health. It is clear, therefore, that starches and sugars should be given as freely as possible. Arrowroot is often well taken by patients with cream and sugar. Cornflour may be added to the milk, and, in the less severe cases, thin bread and butter or biscuits allowed.

DIET CURES AND SPECIAL DIETS

CHAPTER V

DIET CURES AND SPECIAL DIETS

By Edmund Cautley, M.D., F.R.C.P.

Various systems of diet have been devised to meet the requirements of disease, the fancies of the faddist, and the desire of the layman to teach the members of the medical profession things of which they are thoroughly well informed. Some of these systems are based on the elimination of articles of food from the diet list, on æsthetic or humanitarian grounds. Others depend on theories about that bugbear of the lay imagination, "the uric acid diathesis." In many instances the particular modification is due to purely medical reasons, such as the desire for simplicity, the wish to give the digestive functions a complete rest from dealing with some one or other of the various food constituents, or the necessity for limiting the amount of nutriment in the diet without reducing the actual quantity thereof. Often it is merely a question of partial starvation for the time being. Many of the diets, which carry out this object, are those used in the treatment of obesity, and are referred to in that section. The diets dealt with in the present chapter are of use in various conditions of health and disease, in different climates, and for different individuals or the same individual under different conditions of life.

THE MILK CURE

A simple milk diet is one in which milk alone is given fresh, uncooked, boiled or peptonized, whole or diluted with a simple diluent. This is the method of feeding in many febrile and digestive disorders, and is so well known that it needs no further comment. As a definite "cure" milk may be added to the ordinary diet or given as the only article of food. For infants it forms a complete food, but for adults it is wofully deficient in carbo-hydrates. As a simple addition to the ordinary diet, a tumblerful of milk may be given at 11 a.m. and at bed-time. It is the most suitable plan for the treatment of malnutrition.

As an exclusive diet milk may be recommended for all kinds of dropsy, functional and organic disorders of the alimentary tract, hepatic and renal diseases, chronic bronchitis and emphysema, alcoholism, neurasthenia, rheumatic and gouty affections, and for arterial disease. Possibly in the latter it may be disadvantageous, because of the amount of lime salts present, unless it is given in the form of buttermilk. In my experience the treatment is chiefly valuable for chronic affections of the colon and small intestine, associated with toxæmic states. It is useful, too, in the cure of anæmic obesity, when the patient is kept in bed, provided it is only used as a preliminary method of treatment, with a view to reducing the general watery engorgement of the tissues and relieving the strain on the circulation and the heart.

Technique of treatment.—The milk should be obtained fresh twice a day and be thoroughly skimmed. Occasionally it is advisable that the fat be entirely removed by centrifugalization, but this complete separation of fat is not often beneficial. It should be given at a temperature of about 60° F. to 70° F., the room temperature in summer, and warmed in winter. It must not be boiled, unless there is diarrhœa. It must be drunk slowly, sipped. Begin with small doses. They are less likely to cause nausea and disgust, and the semi-starvation at once begins to afford rest and relief to the organs. Karrell recommends a dose of 3–6 oz. four times a day, at intervals of four hours, and no other food. Weir Mitchell recommends 4 oz. every two hours, and that as the dose is increased the interval should be increased to three hours. One dose, with a little lime water, is allowed during the night. As soon as small solid stools indicate that the milk is well digested, the amount may be increased, until finally the patient is taking from 10-20 oz. for each meal. The amount should never exceed six pints daily ; and the duration of the treatment must not be prolonged more than six weeks. Slight modifications may be permitted. Thus, the milk can be flavoured with tea, coffee, pure cocoa, salt or burnt sugar. To counteract acidity, lime water or Vichy water may be added. Or the milk may be scalded by the addition of one-fourth its bulk of boiling water, and salt and carbonate of soda added ; or it may be mixed with barley, rice or oatmeal water.

It is essential that the patient be kept in bed at first, for the diet is small, insufficient, and leads to loss of weight and strength. Sleeplessness may be troublesome in the first week. Later on drowsiness is not uncommon. The tongue becomes coated with a thick creamy fur ; the mouth has a nasty taste in it ; and there is constipation, showing that the milk is absorbed. Flatulence and diarrhœa may arise from too great a quantity, lack of freshness, or insufficient skimming. Thirst can be relieved by plain or aërated water. The mouth should be washed out after each meal. Constipation should be treated by simple enema, castor oil, rhubarb powder, liquorice powder, or the addition of baked apples or stewed prunes to the diet, according to the nature of the case. If in two or three weeks there is keen desire for solid food, a little stale bread and salt, or a salted herring, is given, and once a day some soup made with milk and thickened with groats. In another fortnight it is generally necessary to make some further modification, such as the addition of Benger's food or some other starchy proprietary food.

While on the pure milk diet the stools should vary in colour from yellowish to orange, have a peculiar odour, and be devoid of the typical fæcal smell. The bowels should act every two or three days. The secretion of urine is increased by the lactose in the milk, for it acts as a mild diuretic. The urine assumes "a singular greenish tint," and contains little uric acid.

Milk is a purin-free digestible nutritious fluid, which turns sour readily, but does not undergo putrefaction easily. It is, therefore, a most suitable diet in many intestinal affections.

THE WHEY CURE

Whey differs from milk in containing much less protein and that in the form of lact-albumin, about 0·85 per cent, a slightly higher proportion of sugar, and a mere trace of fat, 0·04 per cent. Its value depends on its characters as a dilute mildly nutritious fluid, easily digestible, non-irritating, and somewhat diuretic. It is especially useful in some of the acute gastric and intestinal affections of infancy, in marasmus, and for premature or debilitated babies who cannot obtain breast-milk and are unable to digest the diluted milk of other animals. Curiously, in infants, it very commonly gives rise to green stools. Whey is, also, useful as the sole diet in enteric fever, as a substitute for milk in jaundice, in renal and other dropsical affections, in abdominal plethora and in some pulmonary diseases.

In **enteric fever** it may be given in doses of 4–6 oz. every two hours, according to the state of the patient and the alimentary tract. Many typhoid cases come to a bad end because of over-feeding and resulting intestinal fermentation, abdominal distension, the passage of undigested stools, and sometimes ileus, hæmorrhage or perforation in consequence of the distension. This state of intestinal distension is rarely developed on a diet of whey. When it has arisen on other diets it may often be relieved by complete starvation, a liberal allowance of water, or a diet of whey only.

In **abdominal plethora** whey is given in amounts up to ten tumblerfuls a day, with a diet of fruit and vegetables. It is best to begin with one glass night and morning and increase by an extra glass daily. It should be taken warm, and given alone or with a mineral water.

The so-called "**whey cure**" is carried out at Ems, Ischl and Reichenhall, for the treatment of chronic laryngeal and bronchial catarrh, and chronic phthisis. It consists of 20 oz. of whey daily and a modified diet, in which animal foods are reduced and vegetables increased. The benefits which may be derived from such a course of treatment are mainly due to the place, the change of scene and climate, and the regular habits and mode of life. It is barely conceivable that the course is a justifiable one for a case of chronic phthisis, for the benefits derived from the climate and mode of life are likely to be more than counterbalanced by the insufficiency of the diet. For catarrhal states, associated with plethoric conditions, the result of high living, the treatment is likely to be beneficial.

The preparation of the whey.—Curdle 30 oz. of milk at 105° F. with rennet. Break up the clot thoroughly and strain through muslin. This should yield from 20–22 oz. of whey. It contains more protein and fat, when made by this method, than if the whey is simply allowed to separate out by contraction of the curd after clotting.

KOUMISS AND KEPHIR CURES

Koumiss is the fermented milk of mares or asses. It is used largely by the Tartars and Khirgis tribes and other nomadic tribes of the South-eastern Steppe country of Russia. It is given as a cure for phthisis in the districts where it is made, with good results, which more probably depend on the climate than the koumiss. It is also made and used in Moscow and St. Petersburg.

The "**koumiss cure**" is carried out in the Steppes of Orenberg and at Annaeff's and Postnikoff's establishments in Ssamara. Annaeff's place is on the banks of the Volga, three versts from Ssamara. It is situated in a park on a hill and is provided with a library and theatre. Patients should only go there in summer, for the winter climate is too severe.

Patients are made to rise early and to take a glass of koumiss every half hour, except during the two hours before dinner and supper. Meats and fats form the chief part of the diet. Sweets, fruits, salads, ices, coffee and spirits are forbidden. At first only a few glasses of koumiss are given, until the patient is accustomed to it, and lime water is added to stop diarrhœa. It is well digested, even in large quantities, relieves constipation, and acts as a diuretic or diaphoretic, according to the temperature of the external air.

Mode of preparation and composition.—The milk is fermented by means of kephir grains. Alcoholic and lactic acid fermentation occur. Milk of mares is the best, because it is rich in sugar. The milk sugar is converted into alcohol, carbonic acid gas and lactic acid. Fat is liable to butyric acid fermentation, and for this reason, too, mares' milk is the best, because it is poor in fat. The resulting fluid varies in composition with the duration of fermentation. A good sample contains about one to two per cent of alcohol and less lactic acid, and is a milky, frothy liquid with a slightly acid taste. The amount of alcohol is not greater than in many temperance drinks. It is more readily digested and more completely absorbed than milk, and can be taken in huge quantities, from 10–15 pints in the 24 hours. As much as three or four gallons may be taken on a hot day in the Steppes. Hence, a considerable amount of nutriment is taken. It is diuretic, mildly purgative, and limits intestinal putrefaction by virtue of the lactic acid and bacilli which it contains. The alcohol is a mild stimulant and food. The carbonic acid encourages gastric secretion. The casein is finely divided, digestible, and does not curdle in the stomach.

Kephir is the product of a similar fermentation of cows' or goats' milk, and has been used for ages among the Caucasian tribes. Kephir grains or beans consist of masses of dried ferment held together by a gelatinous substance. The active agents are the saccharomyces mycoderma and the lactic acid bacillus. In composition it is practically the same as koumiss. A modification of koumiss is made by various dairy companies from cows' milk, by the addition of sugar and yeast. The use of kephir grains was soon abandoned. It is sold under the names of kephir and koumiss. The milk is skimmed or diluted to reduce the amount of fat. The casein is partially predigested, dissolved, precipitated in a state of very fine division, and a small amount of peptone is formed. The taste for these preparations is an acquired one. The artificial product costs about 1*s.* a champagne quart. Begin with small doses, about one pint daily, and increase gradually.

An ordinary amount of koumiss per day would be about seven pints, or 4,000 c.c. Obviously the addition of this amount of food to a diet rich in protein and fat, combined with an open-air life in the pure air of the Steppes and freedom from anxiety, is likely to prove very advantageous in suitable cases of early phthisis or mild fibroid cases. In comparison with the whey cure, in which there is marked underfeeding, the results are likely to be excellent. Koumiss and kephir are practically identical in composition, but in each the actual percentages of the various constituents depend on the duration of fermentation.

	Kephir.		Koumiss.				
	Dujardin-Beaumetz.			After 2 days. Hartier.	Analysis by Stange.		
					6 hours.	18 hours.	30 hours.
Protein	3·8	3·1	2·2	1·12	2·25	2·26	2·00
Fat	2·0	2·0	2·1	2·05	1·89	2·00	1·90
Carbo-hydrate	2·0	1·6	1·5	2·20	1·88	1·63	0·00
Lactic acid	0·9	0·8	0·9	1·15	0·39	0·56	0·64
Alcohol	0·8	2·1	1·7	1·65	1·85	1·95	3·00

Mental and bodily languor and excitement of the sexual organs have been noted as sequels of the treatment. The "cure" is suitable for gastric and pulmonary catarrh, when conjoined with a hot dry climate. Sometimes it is beneficial in anæmia, malnutrition and convalescence from illness. It has been recommended for delirium tremens and hepatic cirrhosis. Chiefly, the artificial product in this country is useful for severe vomiting and gastric and intestinal diseases, associated with putrefaction. Thus, it may be tried with fair hopes of success in chronic infantile ileo-colitis and in the colitis of adults. Apart from these latter disorders koumiss and kephir must be looked upon as aids to treatment rather than as definite curative agents.

LACTOBACILLINE TREATMENT

Analogous to the koumiss or kephir cures, dependent as they are on the presence of lactic acid and lactic acid bacilli, is the treatment of intestinal and other affections by buttermilk or by lactobacilline. **Buttermilk** should be made from sour cream or milk, and be less than 24 hours old. According to Salge, when made from sour cream it contains protein 2·5–2·7, fat 0·5–1·0, sugar 3·0–3·5 per cent; the decrease in the sugar being due to the lactic acid fermentation. It is best made from sour milk previously skimmed. Churn one pint at a temperature of 60° F. to 70° F. for 15 minutes in a glass churn of two pints' capacity. Stand it on ice and use it during the next 24 hours. The casein is finely divided by centrifugalization and separated from its calcium base, and the calcium is transformed into soluble salts, chiefly lactate, about 1·85 grammes per litre.

The acidity is about 0·5 per cent., and the caloric value 300–450 per litre. On heating, the finely divided casein clots in large masses like ordinary sour milk. This can be prevented by constant stirring or by adding carbonate of soda up to slight alkalinity. The clots are composed of casein lactate. Buttermilk is not often taken raw. Usually it is sweetened and sterilized, or is mixed with 10–25 grammes of flour and 35–90 grammes of sugar per litre and brought to a boil three times. The following is another method of preparation. Add one teaspoonful of wheaten flour and four of granulated sugar to a quart of buttermilk, with constant stirring. Then heat to boiling point in a double saucepan, stirring often, and taking care not to curdle the mixture by too much heat. Cool rapidly and keep it in bottles. A condensed buttermilk is sold under the name of "Nutricia" Condensed Buttermilk.

Obviously, fresh buttermilk differs from the cooked preparations in the presence of numerous active lactic acid bacilli which are so easily destroyed by heat. The effects, therefore, will differ according to the mode of preparation.

Another mode of treatment has been devised whereby these bacilli can be given in compressed tablet form, or can be added in the form of powder to milk, with the view to turning it sour by inoculating it with huge numbers of the bacilli. In Paris the "Milk curdled a la Lactobacilline" and "Lactobacilline Broth" can be obtained ready for use, or a lactobacilline liquid for the preparation of such milk. In London it can be obtained from Wilcox, Jozeau and Co. in the form of powders, together with the necessary apparatus for the preparation of the milk, or as tablets which can be given separately. Similar tablets of active lactic acid bacilli are sold by Allen and Hanbury under the name of "Sauerin." The indications for the use of these foods, that is, for the administration of lactic acid or of bacilli, which will produce lactic acid in the intestines, are the same as those of the koumiss cure. They limit intestinal putrefaction and are useful in most forms of enteritis, the green diarrhœa of infants, typhoid fever, colitis, and diseases which can be ascribed sometimes to intestinal putrefaction or the absorption of toxins from the alimentary tract. They may possibly be useful in rheumatism, gout and allied affections, and in arteriosclerosis.

THE PURIN-FREE DIET

A few preliminary remarks on purins and purin metabolism are necessary in order to form a due appreciation of the value of the purin-free diet. Purins are bodies with a base $C_5 N_4 H_4$ (purin) and include :—

Oxy-purins or Oxides of purin.
Hypoxanthin $C_5 N_4 H_4 O$
Xanthin $C_5 N_4 H_4 O_2$
Uric acid $C_5 N_4 H_4 O_3$

Amido-purins.
Adenin $C_5 N_4 H_4$ -NH (amide of hypoxanthin).
Guanin $C_5 N_4 H_4$ O-NH (amide of xanthin).

Methyl-purins
Thein and Caffein $C_5 H (CH_3)_3 N_4 O_2$
Theobromin $C_5 H_2 (CH_3)_2 N_4 O_2$

Xanthin, hypoxanthin, adenin and guanin are called purin bases. The amount in the urine is estimated by the purinometer. About 3 per cent of the nitrogen of the food appears in the urine as purin and 86 per cent as urea, in mammals, so purins are quite of secondary importance to urea. Mammals and birds are not comparable in their nitrogenous metabolism. In mammals uric acid by the mouth appears as urea in the urine; in birds urea, amido-acids, and ammonia appear as uric acid. Urea is an end product of metabolism in mammals, and never forms uric acid, but in birds it is converted into uric acid before excretion.

Laboratory experiments show that uric acid can be split up into alloxan and urea; that alloxan can be converted into parabanic acid and CO_2; and that oxaluric acid is derived from parabanic acid and can be split up into oxalic acid and urea. Hence, uric acid appears to contain two urea molecules, one of which is easily liberated, while the other is only freed with difficulty. There is another way in which uric acid can be split up into the ultimate products, urea, oxalic acid and carbonic acid, but allantoin, a somewhat similar body to alloxan, is formed in the intermediate process. On mild oxidation uric acid yields allantoin and CO_2. On powerful oxidation it splits up into oxalic acid and urea. By hydrolysis uric acid yields glycin (amido-acetic acid), ammonia and CO_2. Glycin *plus* urea forms uric acid. Glycin is found in the tissues and is undoubtedly a decomposition product of purins in herbivora, and probably so in man. Allantoin and oxalic acid in minute traces are normal constituents of urine. Both glycin and allantoin can form urea. In cats and dogs the purin of purin decomposition is only oxidized as far as allantoin, while in man it is further changed into urea. Glycin, allantoin and oxalic acid may all be produced during the disintegration of purin.

Purins are called **exogenous** when they are taken into the body as food, and **endogenous** when they are formed in the body. Vegetable purins are said to be less injurious than animal ones. Exogenous purins are present in meat and meat extracts; glandular organs, especially the liver, thymus, pancreas and kidneys; many cereals; some fruits, e.g. strawberries; vegetables, such as peas, beans, lentils, spinach, asparagus and onions; fungi, e.g. mushrooms; malt liquors; tea, coffee and cocoa.

These exogenous purins are in the form of oxy-purins, amido-purins or methyl-purins, according to the food, and are combined or free. They vary in their effects. Any purin by the mouth increases the purin excretion and always to the same extent, varying with the nature of the purin. Thus, in man, about one-half of the oxy-purins ingested, pure or in muscle, liver or spleen, reappears in the urine as uric acid. In dogs only one-twentieth reappears in this form. Of the amido-purins one-fourth of the nitrogen reappears as uric acid. Of the methyl-purins one-third reappears as basic purin-N. These methyl-purins are peculiar in that they cause an increase in the excretion of purin bases, but not of uric acid. Yet they are oxidized into oxy-purins, and it is known that oxy-purins give rise to uric acid.

That portion of the exogenous purins which is not excreted must be either stored up or disintegrated. Probably it is disintegrated, for it has been found that when uric acid and hypoxanthin are injected subcutaneously, in each case one-twentieth part appears in the urine, although hypoxanthin is much more soluble than uric acid and ought to be much more readily excreted.

In order to study the metabolism of endogenous purins a purin-free nitrogenous diet must be given. On such a diet it is found that the excretion of endogenous uric acid remains stationary and uninfluenced by the nature or amount of the diet, provided that it be sufficient. But the amount of urea excreted varies with the amount of protein given. Therefore, the uric acid does not come from protein. The total purin excretion on the diet is practically that of endogenous purin and a measure thereof. It varies in different individuals, and is constant in the same individual under the same conditions. It is supposed to come chiefly from the muscles and to be increased by muscular work. Recent work by Spriggs has led him to maintain that the greater part of the endogenous uric acid does not come from the muscular tissue, but that endogenous creatinin is mainly, if not entirely, derived from muscle and is the product of its structural metabolism.

The formation of uric acid.—Nucleinic acid, from the nuclei of cells, is split up by a ferment (nuclease) into and sets free purin bases, especially adenin and guanin. The nucleins vary in the nature of the amido-purins to which they give rise. Adenin comes from the thymus, guanin from the pancreas, and both from salmon sperm. By means of a hydrolytic ferment adenin is converted into hypoxanthin and guanin into xanthin. Possibly there are two ferments, adenase and guanase; or only one, in which case guanin is more resistant than adenin to disamidation. Subsequently the xanthin and hypoxanthin are converted by oxidase into uric acid, perhaps in the muscles and before getting into the blood.

Part of this uric acid is destroyed by a ferment in the liver, undoubtedly the purin destructor in dogs, and part is excreted before it is transformed. Thus, the amount of endogenous purins excreted is likely to bear a definite relation to the amount produced in the tissues, as has already been stated to be the case. About half of both the exogenous and endogenous purins is disrupted in the tissues and sets free urea molecules.

We may conclude from the above statement, based on the most recent work on the subject, that the uric acid excretion bears no relation to protein metabolism; that in man it is increased by oxy-purins in the diet; that oxy-purins are derived from adenin and guanin, and these bodies from nuclein; that nucleins in the food give rise to uric acid in the urine, although adenin and guanin by the mouth have apparently little effect; and that the conversion of oxy-purins into uric acid is due to a ferment action.

The purin-free diet in gout is based on the theory that there is retention of uric acid in the system in consequence of abnormal chemical affinities or blockage of the excretory channels, the kidneys. Possibly gout depends on an abnormal endogenous metabolism of purins with which there may or may not be associated a specific insufficiency of the renal epithelium to excrete uric acid. It is difficult to accept the theory of renal inadequacy, for at times the gouty excrete uric acid extremely well. In favour of the retention theory are the presence of uric acid in the blood; the lessened elimination of endogenous uric acid and the large variations therein; the delayed reaction of the urine to the intake of purins; and the formation of tophi. Uric acid exists in the blood as a salt and also as a firm combination with some unknown substance. Possibly the formation of excretable uric acid depends on ferments, or the excess is due to deficiency of uric acid destroying ferment. In gout it is worth while to try the effect of a purin-free diet ; to estimate the toleration for purins ; and to regulate the intake of protein. The relief of gout by drugs, which prevent intestinal putrefaction or eliminate the products thereof, suggests that it is due to toxins. The large amount of indican often, but not always, present in the urine in acute gout supports the view that the toxæmia is due to intestinal putrefaction of protein.

The diet.—A purin-free diet can be devised from a combination of the various purin-free foods. Nuts are the most nutritious and contain much fat ; chestnuts being the most digestible. Macaroni, dates, raisins, and cheese are all purin-free and are mentioned in order of nutritive value. White bread, potato and milk contain minute traces, but so minute that they may be regarded as purin-free. Cream, butter, fats, eggs, apples, grapes, figs and honey are also purin-free. The fruits mentioned are those best for food. The following table shows what foods are rich in purin.

THE PURIN-CONTENT OF FOODS IN GRAINS PER POUND, PINT, OR TEACUP.

Sweetbread	70·43	Salmon.	8·15	Beans .	4·16	Porter. .	1·35
Liver .	19·26	Halibut .	7·14	Lentils .	4·16	Ale . .	1·27
Beefsteak	14·45	Plaice .	5·56	Oatmeal.	3·45	Lager beer	1·09
Sirloin .	9·13	Cod . .	4·07	Asparagus	1·50	Coffee. .	1·70
Chicken .	9·06			Onions .	0·06	Ceylon tea	1·21
Loin of pork	8·48					Indian tea	1·05
Veal . .	8·13					China tea.	0·75
Ham. .	8·08						
Mutton .	6·75						

(Potts : *Lancet*, 1906, vol. ii, p. 933, based on Walker Hall's work.)

The purin-free diet may be tried for gout and gouty conditions, renal disease, headaches and neuralgias, bilious attacks, recurrent vomiting, and chronic affections of all kinds. There is no proof that it is of any decided value, either in modifying or curing these constitutional states. Practically it will be found that the benefit derived from this diet is mainly dependent on its simplicity, on efficient mastication, on the limitation of intestinal putrefaction, and on the prevention of over-eating, which the return to a simple and limited diet involves. Too much, therefore, must not be expected, but it may be justly recommended in conjunction with other therapeutic measures. Even if we accept the view that gout is connected with anomalous purin metabolism, we must remember that this is due to a disorder of the tissues or special organs, and that it is a sequel, not a cause. There is no proof that either uric acids or purins by mouth can give rise to gout, or that they possess toxic properties of importance. On a purin-free diet indicanuria may disappear.

MEAT DIETS

The ingestion of large quantities of meat has been recommended for tuberculous affections because of the infrequency with which they are associated with gouty states. That is to say, it is assumed that the gouty or uric acid diathesis is antagonistic to the tuberculous one, and that it can be induced by a liberal meat diet. A meat diet is also recommended for obesity, setting up a species of starvation; for dyspeptic affections, because of its simplicity and freedom from carbo-hydrate fermentation; and for chronic articular gout, diabetes and psoriasis.

The Salisbury diet is the typical meat diet and consists of 2–4 pounds of meat, beef for preference, and 3–5 pints of hot water daily for 4–12 weeks. The meat is chopped up quite fine with an American chopper, and all gristle, bone, fat and visible connective tissue are removed. It is made into patties, sufficiently firm to hold together, three to four inches in diameter, and half to one inch thick. These are placed in a frying-pan, without fat or water, and rapidly heated, first on one side and then on the other. On removal from the fire they are allowed to stand near it until of a drab colour. Salisbury recommends that they should be broiled slowly and moderately well. Butter, pepper, salt, Worcester sauce, mustard, horseradish, celery salt and lemon juice may be added as condiments. Advocates of this diet have recommended three pounds of rump steak and one of cod-fish, with six pints of hot water daily, for two weeks. For the next three weeks the hot water is reduced to four pints and other kinds of meat are allowed, with a little green vegetable and unsweetened rusks. During the next four weeks the hot water is further reduced to two pints; hock and claret with seltzer are permitted, and grilled meat, poultry or game, crusts of stale bread and captain's biscuits. The meat must not be raw and must be quite fresh.

The hot water should be given in doses of ½ to 1 pint, four or more times a day, say at 6 and 11 a.m., and 4 and 9 p.m., one or two hours before meals and half an hour before retiring. It should be of a temperature of 110° F. to 150° F. and should be sipped slowly in ¼ to ½ hour. If it nauseates, a little tea, coffee, lemon juice, salt or sal volatile (m xxx ad oz. xx) may be added.

Five grains of bicarbonate of potash are sometimes given night and morning.

There are obvious objections to this diet. It is absolutely unphysiological, a starvation diet in respect of fat and carbohydrates. The quantity is much too large for most people. It throws a great strain on the organs which have to do with the metabolism of protein. It is essential to be sure that the kidneys are sound before adopting this treatment.

Zomotherapy is the name given to the treatment of disease by a diet of muscle juice or raw meat. A diet of raw meat and alcohol was recommended for phthisis and pyogenic infections by Fuster of Montpellier in 1865. C. Richet and J. Héricourt in 1889 experimentally determined the value of a raw meat diet for tuberculosis in dogs, and subsequently showed that the benefit was derived from the muscle juice and not from the muscle fibre, deprived of its juice by expression. They found that it was not a matter of hyper-alimentation, for only 50–100 c.c. of the juice, as a daily dose, were sufficient to cure the dogs, whereas hyper-alimentation with the washed muscle fibres had no beneficial effects. The juice contains 2·5 per cent of albuminoid material.

The technique of the feeding is so complex as to render it quite impracticable. The best rump steak of cattle must be obtained, for it is richest in juice. Mutton yields less juice and often has a disagreeable odour and unduly high taste. Horse flesh is cheaper, less efficacious, more toxic and liable to set up enteritis.

The juice must be prepared from **perfectly fresh meat.** If the muscle has undergone rigor mortis it has lost its glycogen, and contains lactic acid and more or less toxic products of decomposition. Hence, the juice should be prepared within two or three hours of the animal's death. If it is prepared from commercial meat it is less beneficial, more toxic and perhaps infective. The animal should be neither overworked nor underfed before death. The meat must be finely minced, wrapped in stout linen, put in a sieve and subjected to slow pressure. Small household presses will yield about 20 and larger presses 30–60 per cent of juice. If one-fourth the weight of sterilized water is added and the meat allowed to stand for an hour or two before compression, more fluid is obtained, but the bulk and the increased decomposition are disadvantages. Presses, mincer and linen should be well boiled or washed in boiling water before use. In hot weather the juice should be collected in a vessel surrounded by ice. Even in winter the juice should be taken at once, because of its liability to decomposition. It is repulsive to the patient and should be given in a coloured glass or with warm beef-tea. It is liable to set up alimentary, hepatic or renal troubles. Intestinal disorders are due to neglect of some detail in the technique, generally to the impossibility of getting the meat sufficiently fresh.

The dose should be 9–15 ounces daily, with or between meals, in water, aërated water, tepid beef-tea, with or without salt or sugar. Three to six ounces is sufficient for early cases. If raw meat is given as much as a pound a day can be ordered, but few patients can take more than one-fourth to one-half pound. Raw meat and muscle juice can be combined in the dietary. No cooked meat should be allowed.

Possibly the muscle juice contains a substance which is antagonistic to the tubercle bacillus and its toxin, for muscle fibres are not invaded by the organism, and during the course of the disease they waste, perhaps being sacrificed in the defence of the body. More probably the good effects depend on the nutritive value of the fluid as a stimulant of the nervous system or of thyroid activity.

There is evidence that defective thyroid activity predisposes to tuberculous affections. These are apt to follow rapid growth at puberty, infectious diseases, prolonged lactation, sexual excess and alcoholism, in all of which the thyroid secretion is liable to be used up and the gland to atrophy from over-stimulation. Raw meat and milk stimulate thyroid activity and, according to Galeotti and Lindermann (1897), the decomposition products of raw meat increase the colloid material of the thyroid. In fowls fed on raw meat the thyroid and parathyroids become enlarged (Chalmers Watson, 1904). No such change was found by D. Forsyth in similar experiments (1907). Milk probably contains some of the internal secretion of the thyroid, for iodine can reach the infant through the breast-milk. Infantile myxœdema rarely develops until after weaning and, moreover, the infant thyroid contains little colloid.

Zomotherapy is indicated in latent, pre-tuberculous and early stages of tuberculosis. If we accept the view that the disease is due to infection in early life, through tuberculous cows' milk, it follows that undercooked meat should enter largely into the diet of young children. Meat juice and raw meat are valuable in anæmia, dyspepsia, neurasthenia, debility, convalescence, typhoid fever and after hæmorrhage. Raw meat is contra-indicated, on account of its stimulating properties and its composition, in excitability of the nervous system, hæmoptysis, arthritis, liver and kidney disease, and pyogenic intoxication. In some of these, muscle juice may be given if the effects are carefully watched.

Improvement is indicated in tuberculosis by increased muscular power, rise of blood pressure, increased hæmoglobin, better digestion, and decrease in physical signs. In the very young the prognosis varies directly as the gain in weight, especially in the first month. Treatment should be continued for a period varying with the extent of the disease and the improvement, and may be resumed at intervals if the health again fails.

On account of the difficulty in obtaining fresh muscle juice a preparation, **Carnine Lefranc,** has been introduced to take its place. It claims to be made from freshly killed healthy animals by a cold process, without the aid of heat of any kind, without any added drug or chemical, and to accurately represent fresh muscle juice. One kilo of beef yields 250 grammes of the juice. It is a sweet syrup, agreeable to the taste, and keeps well. Dose : one to six tablespoonfuls daily, alone or in any fluid, except beef-tea, cold or tepid.

VEGETARIANISM AND ITS MODIFICATIONS

The strict **vegetarian** takes no animal food and no tubers or foods grown underground, limiting the diet entirely to fruits and vegetables grown in the sunlight. Others live on a diet of fruit and nuts, with milk. In a third class may be placed those who exclude fish, flesh and fowl ; and in a fourth those who merely exclude food obtained by the infliction of pain. Those who live on fruit, nuts and milk, are sometimes called **fruitarians** or **nutarians.** Those who take a mixed diet of milk, milk products, eggs, vegetables, fruits and nuts are often called **lacto-vegetarians.**

Cereals, vegetables and fruits differ from animal foods in containing comparatively much carbo-hydrate and little protein. Starch is derived from cereals, bananas and chestnuts. Many fruits are rich in sugar. The animal kingdom supplies man with protein food, and the vegetable kingdom provides carbo-hydrates, except honey, fats being derived about equally from both sources. The carbo-hydrates are stored up as starch and circulate, during the life of the plant, as sugar. In the uncooked state the starch is indigestible, for it is enclosed in envelopes of insoluble cellulose. During cooking the granulose of the starch cell swells and bursts its cellulose envelope. Dry heat dextrinises starch. In some plants, e.g. the sugar-beet, the carbo-hydrate is mainly in the form of sugar. Another carbo-hydrate present, especially in fruits, is pectose or a pectin body. It is convertible into pentose, which is partially assimilable. This body is sometimes called vegetable gum. It causes the jellification of fruit on boiling.

The percentage of carbo-hydrates varies in different vegetables and is highest in the **tubers**. Much is dissolved out in the process of boiling. Such vegetables should be cooked by steaming.

THE PERCENTAGE OF CARBO-HYDRATES IN TUBERS.

	Raw.	Boiled.
Onion	6·3	0·70
Turnip	5·0– 8·1	0·65
Carrot	7·0–10·1	3·40
Beetroot	9·7–11·0	2·81
Parsnip	13·8	1·43
Artichoke	14·4	4·60
Potato	19·1–24·4	16·9–18·7
Radish	4·6	—
Yams	15·3	—
Sweet potato	22·5	—

In the above-mentioned tubers the protein and fat are negligible quantities. Obviously many of them are most innutritious, when boiled in the ordinary way. Ninety per cent of the carbohydrate of the sugar-beet is sugar.

Green vegetables are practically fat-free; contain very little protein, and of that one-tenth is lost in cooking; and contain from 2–8 per cent of carbo-hydrate, of which one-third is lost in cooking. They possess the advantage of being able to take up a great deal of fat on cooking. They are liable to set up intestinal fermentation unless quite fresh. The proteins are not as readily absorbed as animal ones. They are chiefly globulins, soluble in dilute saline solutions and consequently largely dissolved out during cooking.

Extractives are plentiful in vegetables and fruits, chiefly in the form of amides. It is generally asserted that vegetable purins are less injurious than those of animal origin, because they are not combined with the toxic products of decomposition. Of this there is no proof. It is more reasonable to suppose that the evil effects, if any, of the animal purins are due to the decomposition products rather than to the fact that they are of animal origin.

Fats are negligible constituents of vegetables and fruits, except nuts. These, in the dried state, contain a percentage varying from ten in chestnuts to sixty or more in walnuts, filberts and hazel nuts. Olein is the predominant fat. Vegetable fats are apparently quite as nutritious and more digestible than animal fats.

Water is present in huge proportions in green vegetables, many tubers, and almost all the fruits, with the exception of nuts. The proportion is increased by cooking and decreased by drying and compression. The chief feature of the saline constituents is the excess of potassium salts.

THE GENERAL COMPOSITION OF FRUITS AND NUTS.

	Fruits.	Nuts.	
		Fresh.	Dried.
Water	80·0–90·0	38–48	3·5–7·0
Protein	0·5– 1·0	5–12	10–24
Fat	0·5– 1·0	28–35	50–65
Carbo-hydrates	5·0–20·0	10	7–14
Cellulose	2·5– 7·5	1–2	3–5
Mineral ash	0·5– 1·0	1·5	2·0

For practical purposes it is worth while stating roughly the **amount of carbo-hydrates** in the various **fruits.**

0–5 per cent.: Blackberry, cranberry.
5–10 ,, ,, Bilberry, raspberry, peach, water melon, strawberry, currant, gooseberry, orange, lemon, pine-apple, cherry.
10–15 ,, ,, Mulberry, pear, apricot, apple, greengage, plum.
15–20 ,, ,, Grape (varies from 10 to 30), nectarine, fig, prune.
20–25 ,, ,, Banana.

Dried fruits contain still more; a percentage varying from 60 to 75 in dates, figs, prunes, currants and raisins. These are particularly valuable as food.

From half to three-fourths of the carbo-hydrate is in the form of sugar, usually lævulose. Apricots, apples and pine-apple also contain cane sugar. The remainder is in the form of pectin bodies or vegetable gum. The amount of cellulose is variable. The fruits also contain organic acids, in combination with potash, which increase the alkalinity of the blood, and urine.

Bananina is a proprietary food made from bananas. It is a flour, the fibrous portions of the fruit being extracted, and in composition is analogous to rice flour. It contains about one-half per cent of fat, and about half the amount of protein, and rather more carbo-hydrate than is present in wheat flour. A kind of bread is made from it. The richness of nuts in fat has led to the preparation of butter substitutes from them, e.g. **albene** (9*d.* per lb.), of which one ounce is said to be equivalent to $1\frac{3}{5}$ oz. of butter; **nucoline** (6*d.* per lb.), 1 oz. equal to $1\frac{1}{2}$ oz. butter; **vegsu,** or vegetable suet; **nut butter** or **nuttolene,** equivalent to cream and containing protein; **cocoa butter, cocoleum, cocolardo; nucoa** and **Loder's cacos**, substitutes for cocoa butter. **Fromm's extract** is made from crushed nuts, the cellulose and excess of oil being removed, (price 3*s.* 6*d.* per lb.). The percentage composition is :—water 25·3, protein 21·9, fat 31·6, carbo-hydrates and cellulose 8·3, salts 12·8. **Malted nuts** contain water 4·5, protein 23·6, fat 20·4, maltose 49·3, salts 2·2. **Nuttose, bromose** and **nut meal** are similar foods.

Almonds and pistachio nut kernels are valuable, for they contain protein 20, fat 50, carbo-hydrates 10 per cent, or even higher proportions. Chestnuts yield the largest amount of carbo-hydrates of any of the nuts.

Analysis of Chestnuts (Balland).

	Fresh.	Dried.
Water	52·8 –62·6	—
Protein	2·1 – 4·3	4·45–11·05
Fat	0·45– 1·73	1·17– 3·74
Carbo-hydrates	31·54–40·74	82·17–88·61
Cellulose	0·74– 1·36	1·76– 3·29
Mineral ash	0·57– 1·22	1·24– 3·06

Boiled chestnuts contain 70, and roast ones 40 per cent of water. The tomato is so common a food that its composition should be known. Albahary (Comp. Rend. de l'Acad. des Sciences, 1907) gives the analysis as :—water 93·5, carbo-hydrates 3·6, insoluble organic matter 1·69, nitrogenous matter 0·95, fat 0·2, insoluble inorganic matter 0·11, ash 0·74 (calcium phosphate 0·12), citric acid 0·69, malic acid 0·48, and traces of oxalic, tartaric and succinic acids. Its nutritive value is evidently small.

In a vegetarian diet the proteins must be obtained mainly from the **pulses.** These contain much nitrogen, which, except about 3–5 per cent, is in the form of legumin or vegetable casein. They are well digested if properly prepared but, if cooked in the ordinary way and in hard water, they are indigestible. The protein combines with the lime. Such foods should be finely powdered before cooking. Some of the pulses, notably beans, are rich in sulphur, and cause flatulence from the formation of sulphuretted hydrogen gas. Lentils contain very little sulphur. Revalenta Arabica is an expensive kind of lentil flour and less nutritious than ordinary lentil flour, being poorer in nitrogen. Another feature in the composition of the pulses is the relatively high proportion of lime. It may possibly be a disadvantage to their free use, as liable to lead to premature calcification of the arteries. Pulses are poor in fat and are usually taken with fatty foods, e.g. beans and bacon ; and they are comparatively poor in phosphates.

The **composition of pulses** as regards protein, in ascending order from 20–32 per cent, is as follows : butter beans, dried peas, Soy beans, broad beans, horse beans, peanuts, lentils, and haricot beans. Green peas contain 4, scarlet runners 1·7, and French beans 1·5 per cent of protein, when cooked. Carbohydrates are present in most of them in amounts exceeding 50 per cent., while Soy beans contain 28, peanuts 17, green peas 12–16, French beans 7, and scarlet runners 3·5 per cent. The amount of fat does not exceed 2 per cent, except in Soy beans 18 and peanuts 44 per cent.

The consideration of the constituents of the above food-stuffs shows that one of the chief advantages of the vegetarian diet, pure and simple, is the reduction in the nutritive value of the food, although as large or a larger bulk is taken. Proteins are especially deficient. The abolition of animal foods, except eggs, milk and milk products, from the diet has its advocates among those who consider the slaughter of animals unjustifiable or have æsthetic objections to flesh foods. No doubt this is a charming fancy of delicate and highly sensitive women and among sentimentalists. Carried out thoroughly to its logical conclusion it would have a most profound effect on life generally. Under such a scheme of diet all animals, except those used for draught purposes and pleasure, would gradually be abolished. Were fowls only kept to supply eggs and feathers, the price of eggs would rise considerably. So, too, the supply of milk would be insufficient and its price prohibitive, for cattle could not be kept profitably for the supply of milk and leather alone. Woollen clothing would become the luxury of the rich. The bulk of the grass grown would be absolutely wasted unless the science of the vegetarian were able to prepare from it a food for man.

The productive value would be, however, increased if grass were converted into arable land for the growth of cereals and sugar beet, and into orchards for fruit and nuts. We should have an insufficient and expensive supply of milk, milk products and eggs, wool and leather. We should be dependent on cotton and linen for clothing and on compressed cellulose for boots and many other purposes.

But although universal vegetarianism is opposed to the scheme of nature, there are cases in which the diet, or one modified by the addition of milk and eggs, is particularly suitable for some individuals and in certain diseases. Notably, as has been stated above, its advantage largely depends on a relative starvation, when compared with the previous diet. The patient no longer overeats. Vegetarians claim that they live longer and are healthier, physically and morally, than flesh-eaters. They may be healthier physically, if they have been subject previously to ailments due to an excess of nitrogenous food or overeating generally. The diet is more suited to those engaged in hard physical work, for they sweat freely and get rid of the excess of water in the diet, and they require much carbo-hydrate food to provide for muscular energy. A sedentary person on a vegetarian diet is liable to develop a distended flatulent abdomen, watery blood, and diarrhœa from the excessive peristalsis set up and the excess of waste products to be got rid of. A nutarian diet, is, on the other hand, more liable to cause constipation.

The relative value of the vegetarian and the mixed diet is a question of protein digestibility and absorption. Practically all carbo-hydrate, except honey and the sugar in milk, is derived from the vegetable world. Fat comes from both sources. Can the vegetable world supply the necessary protein in a suitable form? The protein derived from the animal world is in a concentrated, digestible and assimilable form. That from the vegetable world is in an unduly bulky form or, if concentrated, very indigestible. Dried lean beef will contain as much as 87, and fat beef 51 per cent of protein. Pea flour contains at most 27 per cent, wheat flour 16 per cent, and rice flour 7 per cent. If an average man lived on pea flour containing protein 20, carbohydrate 60, fat 1·5 per cent, he would have to consume twenty large bowls of pea-soup, each containing one ounce of the flour, in order to take 120 grammes of protein a day. This would provide 9 grammes of fat, 360 of carbo-hydrate, and a calorie value of about 2,000. If the soup were made with milk, the number of bowls might be reduced to six, each containing one ounce of flour and half a pint of milk. The total yield would be ;—protein 110, fat 75, carbo-hydrate 190 grammes, calories 1,900. This is more of a milk diet than a vegetarian one. The calorie value of three pints of milk is about 1,200. By adding eggs, cheese, bread and butter the amount of pea-soup could be still further reduced.

By choosing suitable pulses, nuts and cereals, a diet can be devised which is devoid of animal food and not very bulky. The nuts would have to be relied on for fats. Vegetarian, fruitarian, or nutarian diets are much better when combined with eggs, milk and milk products.

Animal proteins appear to develop mental energy and increase the bodily resistance to disease better than vegetable ones. The meat-eating races are physically more powerful, more intellectual and more progressive than others. Carnivorous animals seem to have a vital energy which is more alert than that of the herbivorous and cereal feeders.

The **digestibility of foods** depends on composition and bulk. A diet of bread and vegetables is more bulky than a mixed diet and mechanically interferes with digestion. Green vegetables, many tubers and most fruits have been shown to contain little nutriment in comparison with their bulk. Cellulose is indigestible, innutritious, and interferes with the mixing of the digestive juices with the nutritive materials in the food. Mechanically, a large amount of material has to be dealt with, driven through the alimentary canal, and got rid of. Hence arise the large abdomens of vegetable feeders, e.g. cattle, horses at grass, etc., the "potato-belly" of the Irish, and the large stools. The increased bulk needs increased peristalsis, a liberal blood and nervous supply to the viscera, and an undue expenditure of nervous energy on the digestive processes. To compensate for slow digestion herbivorous animals have huge cæcums and a longer alimentary canal than carnivora and mixed feeders.

Absorbability varies inversely as the amount of cellulose present and directly with the quality of the cooking. An American observation on a diet of fruit and nuts showed that the following percentages were absorbed: protein 82·5, fat 86·9, non-nitrogenous substances 96. Tofu, a Soy bean preparation made in Japan, consists chiefly of bean protein precipitated in combination with magnesium and calcium salts, and has a co-efficient of digestibility for protein of 96, fat 97, carbo-hydrate 88 per cent. These must be compared with the absorbability of (1) Animal Diet: protein, 100; fat, 80–90; (2) Mixed Diet: protein, 92·5; fat, 95; carbo-hydrate, 97·5. The results are in favour of the mixed or animal diet, but depend partly on the preparation of the food. Prolonged vegetarianism does not improve the absorptive capacity and the waste of nitrogen is considerable, much being lost in the fæces.

The **cost of cooking** is a serious item in the vegetarian diet. Although many of the foods are cheap, in comparison with animal foods, they may contain so little nutriment that from the point of view of nutritive value they are very expensive. Cooked celery and onions contain hardly any nutriment. The cost of cooking and the fuel bill is very much greater.

Protein food is **essential for growth** during early life, and the effect of deficiency is shown in the relatively stunted development of the poor as compared with those who obtain a proper food supply. That animal protein is the proper kind to take is suggested by the fact that the proper diet for the infant is the mother's milk or that of some other animal. Under a system of universal vegetarianism it has been shown that the supply of milk would be small and quite out of reach of the poor. Later on in life it is probable that quite two-thirds of the necessary protein can be taken in vegetable forms.

The **lack of resistance to disease** is obvious when the diet is devoid of sufficient protein or of animal protein. Thus, phthisis and epidemics are common among the Irish poor and the lower classes of large towns. Possibly this would not be so evident if the diet could be enriched in protein and fat by means of pulses and nuts. The protein value of a fruit and nut diet is small. Jaffa in California found that in two subjects 8 grammes of nitrogen, and in two others 10 grammes, were sufficient to maintain nitrogenous equilibrium. Such figures have been found by Chittenden sufficient for all classes of people and, if we accept his conclusions, the amount of protein required for the daily ration can be reduced to one-half the accepted standard. The amount varies in different individuals and in the same individual at different times. Further, it is doubtful whether it is wise to live on a minimum diet of protein food, for protein tissues are only built up slowly from the protein consumed, and loss of nitrogen is only slowly replaced. Nevertheless, the subjects of Jaffé's observation had maintained excellent health for years, though they did not look robust.

A fruitarian diet is very suitable during an **acute illness,** such as pneumonia, and should consist of :—

> Milk, 2 oz. every 2 hours ; cold, warm, never boiled ; diluted. The juice of grapes, oranges and pine-apple ; grapes, bananas, cooked apples, etc.
>
> White of egg. Egg lemonade, i.e. the whole of one egg, half a lemon, half a pint of water, and sugar.

The ordinary fruitarian diet of fruit and nuts must be modified in accordance with the foods in season and their composition. Nuts supply the protein and fat. Chestnuts and bananas provide the carbo-hydrates. All fruits will yield some carbc-hydrates and protein. Acid fruits should be taken in moderation. Stone fruits sometimes disagree. Lemon juice should be used in preference to vinegar for salads, as less likely to cause dyspepsia. The excess of potassium salts must be counteracted by common salt. Nuts should be well ground up in a nut mill. Food should be eaten slowly and not more than three meals a day taken. Two meals are sufficient. It is not advisable to omit milk.

Chittenden made observations on a man, aged sixty-three, a fruitarian for 20 years, who did a little gardening and walked four to eight miles daily. At times he took a little vegetable and cereal food. The average daily intake of fruit and nuts yielded protein 40, fat 54, carbo-hydrate 286 grammes, crude fibre 56; calorie value 1,700.

Vegetarian diet (Chittenden) of a man, aged 38, weight 61 kilos:—

First meal: Oatmeal, 227 grammes; butter, 10; sugar, 35; milk, 60, coffee, 210.
Second meal: Macaroni, 142; cheese, 10; bread, 71; sweet potato, 119; milk, 250.
Third meal: Bread, 80; butter, 20; mashed potato, 176; string beans, 77; apple-pie, 82; milk, 250.
Total nitrogen, 10 grammes. N-excretion in urine 8.5 grammes. Calories over 2,000.

Caspari and Glaessner found the nitrogen was 8·27 grammes, fat 218·9 grammes, and the calorie value 4·554, of a vegetarian diet which consisted of coffee 20, sugar 40, grapes 230, nuts 113, oil 154, potatoes 1,005 and carrots 30 grammes.

Fletcher, weighing 57·3 kilos, took ten meals daily, and gained 0·2 kilos in spite of considerable exercise, on a diet containing 1,300 calories of heat. It consisted of potatoes 159·4, eggs 124·7, milk 710, cream 237 grammes. While under Chittenden's observation and weighing 165 lbs. he took a diet of protein 45, fat 38, carbo-hydrate 25·3, calories 1,600, in the shape of milk, cereal food and maple sugar. Weight and nitrogenous equilibrium were maintained and he was capable of hard exercise. Such cases support the contention that the limitation of the diet is one reason of the success of vegetarianism and allied methods of feeding.

These diets are suitable for the constipated and the corpulent, because of the large residue and the small nutriment. If they do not remedy the constipation they do harm by increasing the amount of waste matter. They are sometimes useful in the rheumatic and gouty diatheses; for migraine, recurrent headaches, neuralgias; for neurasthenia, epilepsy and hysteria, if dependent on intestinal toxins derived from meat; in nervous insomnia, exophthalmic goitre, chronic alcoholism, functional cases of dyspepsia and intestinal disorders; and in some skin diseases.

Diets of this nature should be commenced gradually and may be continued for six weeks at a time, if beneficial, and in a more or less modified form for the remainder of life.

THE GRAPE CURE

The grape cure is usually carried out at places like Meran and Montreux, but is available wherever grapes can be obtained. It is a mode of treatment which depends for its good results on change of diet and manner of life, the climate and surroundings, and the aperient effect of the grapes. When aided by a good supporting diet it is suitable for the overworked, the weak and the convalescent. In conjunction with a spare diet, limited particularly as to fat and carbo-hydrates, it is valuable in obesity. The laxative effects render it suitable for cases of abdominal plethora; for passive congestion of the abdominal viscera due to heart disease, chronic bronchitis and emphysema, and hepatic affections; for piles and for chronic constipation. It may also be of value in the treatment of gastric and intestinal catarrh, vesical catarrh, calculus, gouty concretions, and malarial cachexia. As a cure for phthisis its value depends on climatic conditions and liberal feeding.

König gives the composition of grapes as: water, 78·19; nitrogenous matter, 0·59; free acids, 0·79; sugar, 14·36; other non-nitrogenous substances, 1·96; cellulose and pips, 3·60, mineral ash, 0·53. The salts are chiefly potash salts, and salts of lime and magnesia. The percentage of sugar varies considerably in different grapes and is often as much as to 20 to 30.

Mode of treatment.—Begin with half a pound of grapes when fasting, or an hour or two after a light breakfast, and again at 5 p.m. In three days give a third half pound at noon, or after the midday meal, if there is dyspepsia. Gradually increase the dose to one pound at a time. The aperient effects are manifest in a few days. It is rarely advisable to give more than two pounds in lung cases; three pounds in gastric and intestinal catarrh, the diet being carefully regulated at the same time; and four pounds in other conditions; but the amount may be increased to five or six pounds for abdominal plethora, hepatic constipation and chronic constipation. Figs and prunes can be added to relieve the monotony of the diet. The course of treatment lasts for six weeks. Small quantities of white bread may be eaten after the grapes to remove acids from the teeth and, if the gums become irritated, the mouth should be rinsed out with bicarbonate of soda solution.

TUFNELL'S DIET

Tufnell's treatment of aneurism is a modification of the methods adopted by Albertini and Valsalva, who treated their patients by bleeding, rest and modified diet. Bellingham omitted the bleeding and devised the method of treatment in 1852, and it was continued by Tufnell, who published a monograph on it in 1875. The objects are the reduction of the force and frequency of the heart's action, and to favour the deposition of fibrin on the wall of the aneurismal sac. The coagulability of the blood is not increased. The treatment is only suitable for cases of saccular aneurism, unassociated with disease of the aortic valve, and for patients who are sufficiently intelligent to understand the importance of carrying it out strictly, and have sufficient strength of will to put up with its discomforts.

Valsalva kept his patients in bed for forty days, on a limited diet, and bled them frequently. Tufnell recommended 8–12 weeks recumbency. Bellingham's diet is much the same as Tufnell's.

	Bellingham.	*Tufnell.*
First meal.—	Milk or tea, 2 oz.	Milk or cocoa, 2 oz.
	Bread, 2 oz.	Bread and butter, 2 oz.
Second meal.—	Liquid, 2–4 oz.	Water or light claret, 4 oz.
	Bread, 1–2 oz.	Bread or potato, 3 oz.
	Meat, 1–2 oz.	Boiled or broiled meat, 3 oz.
Third meal.—	Liquid, 2 oz.	Milk or tea, 2 oz.
	Solid, 2 oz.	Bread and butter, 2 oz.

Tufnell's diet contains 8 ounces of fluid and 10 of solids. These amounts need not be strictly adhered to. Thus, a suitable diet for a nine stone man would be meat 3–4 oz., bread 2 oz., potato ½ oz., butter ½ oz. A heavier patient might have double the quantity of all the different articles mentioned, except the meat.

Occasionally the treatment results in complete cure. The patient should rest on a water bed and remain absolutely still, doing nothing whatever for himself, a restriction which few people have the strength of will to adhere to. The mouth may become so dry and parched that even the limited amount of solids cannot be taken. Sucking a pebble or button will relieve the thirst a little. Another great trial to the patient is painful micturition, because of the extreme acidity of the urine. It can be reduced by alkalies. Constipation must be relieved by oil enemata, if necessary. There is so little waste matter in the food that an action of the bowels once a week is sufficient. The heart and aneurism must be carefully watched. If the pulse becomes more and more frequent, the patient restless, and the dryness of the mouth so great that he is unable to take food, the treatment must be modified. It has largely fallen into disuse because good results are so infrequent. Hospital patients are particularly unsuited. The aneurism is usually dependent on atheroma from strain or syphilis, is frequently associated with aortic disease, and self-control, especially in the matter of drink, is lacking. Judging by the results of hospital treatment the diet is almost useless, and for this reason most physicians condemn it. The principle may be adopted to a less severe extent. Much benefit is derived from limitation of the fluids to about one pint and of food to half, or less than half of the usual allowance.

THE WEIR MITCHELL DIET

Weir Mitchell's treatment for neurasthenia and disorders of malnutrition, independent of organic disease, depends on isolation, massage and overfeeding. The isolation and the moral effect which can be exerted on the patient, to stimulate the will power, are the main factors. A liberal diet is given consisting of milk 3–4 pints, meat ½–¾ pounds, eggs 4–6, bread, potatoes, sweets, vegetables and butter ; enough to yield protein 150–200 grammes, fat 75–100 grammes, carbo-hydrates 400–500 grammes, and calories 3,500–4,500.

THE TRAINING DIET

A few words may be added about the diet of athletes. Usually it has been based on an excessive supply of meat, on the assumption that the wear and tear of muscular tissue is great and that meat is the source of strength and less fattening than other foods. The nervous energy of carnivora is quoted in this connexion. Although the race-horse is the fastest animal for a reasonable distance, the carnivora can maintain a short burst of speed which is even greater. Possibly a liberal meat supply may be good for the short distance runner, but it certainly is not a suitable diet for prolonged exertion. The general principles of training are the reduction of weight by the removal of superfluous fat, and the improvement of the tone of the muscles and heart, inducing " long wind " and endurance.

Chittenden's experiments on athletes strongly support the view that a high protein diet is unnecessary. The average daily N-excretion of eight athletes on a reduced protein diet was 8·81 grammes for the lot. The average for each individual ranging from 7·39 to 10·07 grammes. This 8·81 grammes of urinary nitrogen is obtained from a protein intake of 55 grammes. The results were much the same as in soldiers on a prescribed diet. The strength of the athletes was markedly increased. They all felt more efficient. The meals were selected from the articles mentioned below.

Breakfast.—Coffee, rolls and butter; bananas, fruit; hominy with sugar and cream, farina, Indian meal, baked potato, boiled rice, or oatmeal.

Lunch.—Coffee, bread and butter ; spaghetti, potato, stewed tomato, boiled onions, string beans, fried hominy and syrup, oysters, cold tongue, baked apple.

Dinner.—Soup: pea, cream of celery, bean, tomato ; fish, bacon, sausage, chicken, lamb chop, steak ; fried or boiled potatoes, spinach, lettuce, celery, apple salad, Lima beans ; cream puffs.

Such a diet, when compared with some of the diets taken by boat crews, football teams and "strong men" is extraordinarily small and suggests that the latter are grossly overfed.

	Protein.	Fat.	Carbo-hydrate.	Calories.
	Grms.	Grms.	Grms.	Grms.
Boat crew (America)	155	177	440	4,085
A "strong man"	224	151	502	4,462
Football team	181	292	557	5,740
" "	270	416	710	7,885

The training diet should be a mixed one of proteins, fats and carbo-hydrates; divided into three meals a day which should be of simple, easily digestible food, and should be eaten very slowly so as to ensure efficient mastication. There is no objection to the use of tea, coffee, cocoa, beer and light wines in moderation. On the whole, water is better than stimulants. No one food should be decreased unduly, except that in hot weather, and to a less extent in cold, the fats should be reduced and partly replaced by carbo-hydrates. Sugar is a most valuable source of muscular energy. Miners in hard work consume large quantities. Probably coffee and sugar is the best stimulant and food to take before entering on a prolonged trial of endurance.

PATENT AND PROPRIETARY FOODS

CHAPTER VI

PATENT AND PROPRIETARY FOODS

By Edmund Cautley, M.D., F.R.C.P.

A "**proprietary**" or "**patent**" **food** is one which is made from one or more simple articles of diet, and is more or less modified in the process of preparation. These foods may be made from milk or milk products; from carbo-hydrates, with or without a basis of milk; from meat, fish, or eggs; from vegetables, fruits, or nuts; and occasionally from fatty substances. In some cases the food is merely modified, in the relative percentages of its component parts. In others, one or more of the different constituents are separated and altered. In some, partial or complete predigestion of the natural food is carried out. Most of them are subjected to the action of heat. A few are prepared by what is known as "the cold process." Judging by the huge sums of money spent on advertising these food specialties, there must be an enormous sale, and it becomes necessary to investigate the claims which are made on their behalf from the standpoints of nutritive value, economic worth, and æsthetic, mental, and social considerations. The majority of these foods are advertised as specially valuable for the feeding of infants. These will be considered in conjunction with other foods of similar composition and their value then commented on. Some foods are merely altered sufficiently to render them more digestible, palatable and nutritious; or to make them less bulky, for the purposes of travelling.

The value of reduction in bulk is considerable in the case of condensed milk, dried and compressed vegetables, meat powders and pemmican. The claims of meat preparations are generally based on the theory that there is a great concentration of nutriment in little bulk. Many well-known advertisements make an appeal to the imagination and lack of intelligence of the public. It is an appeal which is described in philosophy as the *suggestio falsi.*

It may be definitely and positively stated that proprietary foods are not necessary, either in sickness or in health. They are neither more nutritious nor more easy to take than the home-made modifications, which can be easily prepared from the common articles of diet, except in the case of some foods which are predigested or contain partially converted starch. Nor can they be regarded as of special value because of their appetising properties. The meat preparations are powerful stimulants of the secretion of gastric juice, but they have no more value in this respect than ordinary beef-tea and clear soups.

Nevertheless, proprietary foods are sometimes useful on account of their high cost, their pleasant flavour and their variety. A patient can generally be induced to take regularly some special oat food, in the form of porridge for breakfast, or some proprietary carbo-hydrate food at bedtime, instead of the ordinary porridge, milk, or gruel. Some of the meat jellies are indirectly useful, when it is advisable to partially starve a patient, for they are regarded by the public as extremely nutritious foods. Partial predigestion of starchy foods is valuable for children and adults, but is of doubtful service when applied to meat foods. The peptonization of protein in the stomach is dependent on pepsin and hydrochloric acid. If the gastric digestion of protein fail, it is due to deficiency of hydrochloric acid and not to lack of pepsin. When the pepsin is deficient it will be found that the secretion of acid is also defective. Apart from this it must be remembered that gastric digestion is not essential and that the stomach may be regarded merely as a receptacle of food. All foods can be digested fully in the intestines. On the other hand, the physiological arguments against the necessity for the predigestion of food are to a certain extent upset by practical experience. Partial predigestion, more especially in the case of milk proteins, is undoubtedly of very great advantage in many diseases. From the economic point of view all these foods are much more expensive than common articles of diet of equal or greater nutritive value. So also the ordinary articles of diet, which are the most appetising and most delightful to the trained palate, are often enormously expensive in proportion to their nutritive value. The price is by no means everything, but is nevertheless a most important consideration for the poor.

PURE FOODS

Proprietary foods are sometimes ordered with a view to increasing the quantity of some particular primary food-stuff in the diet, whether protein, fat, or carbo-hydrate. Yet there are ordinary articles of diet, almost universally available, which will provide all that is needed.

Assuming that an extra amount of protein food is required, it can be given in the form of white of egg, dried meat powder, or junket made from skimmed milk. The egg and junket are purin-free foods. Meat powders can be bought with advantage in the form of a proprietary food. The extra cost is outweighed, perhaps, by the trouble involved in making such a food at home. So, too, milk proteins can be obtained, in a purer form than junket, from the makers of the various preparations of dried milk casein. As a general rule it is unnecessary to increase the amount of protein in the diet beyond what is being taken in the ordinary diet. Three pints of milk will supply enough protein for most people when in bed. Occasionally meat powders or dried milk foods are useful additions to the diet of patients who can only take liquid or semi-solid foods, as in the case of œsophageal obstruction. Fats are available in the form of pure olive oil, butter (80 per cent fat), margarine, dripping and cream. Mutton fat is less easily digested and absorbed than other fats, especially when hot, more passing out in the stools.

Extra carbo-hydrates can be given in the form of cane sugar, milk sugar, honey, treacle or golden syrup, and maple syrup. Barley sugar and sugar candy are practically pure preparations of sugar. Toffee, too, is a valuable sweet, being a mixture of butter and sugar, the latter considerably inverted in cooking and rendered more apt for digestion.

THE COMPOSITION OF HONEY.

Water	13–16
Invert Sugar	74–78
Cane Sugar	2·69
Protein	1·30
Mineral ash	0·12

Malt extract contains from 60 to 70 per cent of carbo-hydrates, of which about three-fourths is sugar. It costs four times as much as honey and its calorific value is less.

Proprietary foods may be classified as follows :—

I. Prepared from cows' milk.

A. Condensed milk, without added sugar.
B. Condensed milk, with added sugar.
C. Dried milk preparations.
D. Predigested milk.
E. Modified milk.

II. Cows' milk with carbo-hydrate (cereal) additions.

A. The starch practically unchanged.
B. The starch partly or entirely converted into soluble carbo-hydrates, viz. dextrins, maltose and dextrose.
C. The milk partially digested, or the food contains ferments which partially or entirely convert the protein and starch during preparation.

III. Carbo-hydrate foods.

A. Starch, practically unchanged.
B. Starch, partially changed into soluble carbo-hydrates.
C. Starch, completely changed.
D. Malt extracts.

IV. Nitrogenous foods.

(1) From meat.
A. Meat Teas.
B. Meat Extracts.
C. Meat Juices.
D. Peptone Preparations.
E. Meat Powders.
(2) From fish.

(3) From vegetable foods.

(4) From vegetable and animal substances.

V. Fatty foods.

VI. Combination foods.

A. Fat and protein.

B. Fat and carbo-hydrate.

C. Fat, protein and carbo-hydrate.

The composition of the different foods is given in the following tables arranged in alphabetical order, for the purpose of reference. The analyses are those deemed most reliable, but must not be taken as being absolutely accurate.

THE COMPOSITION OF PROPRIETARY FOODS.

Most of the analyses, except where otherwise stated, are those given by the makers.

Name.	Water.	Protein.	Fat.	Carbo-hydrates.		Ash.	Remarks.
				Soluble.	Starch.		
Albany Food	8·60	9·50	2·10	79·40		0·40	Much unchanged starch.
Allenbury No. 1 Food	1·82 5·70 83·30	10·70 9·70 1·56	16·79 14·00 2·30	65·51 66·85 7·20	1·10 — —	4·08 3·75 0·60	Analysis by Fresenius. Ready for use: Hutchison.
Allenbury No. 2 Food	2·24 3·90	10·23 9·20	14·94 12·30	67·54 72·10	1·24 —	3·81 3·50	Analysis by Fresenius. A malted meal *plus* No. 1 Food.
Allenbury No. 3 Food	3·00 6·50	10·33 9·20	1·05 1·00	22·21 82·80	62·91	0·60 0·50	Analysis by Fresenius. Partly malted wheaten flour.
American-Swiss Food	5·68	10·54	5·81	45·35	30·00	1·21	Much cane sugar.
Anglo-Swiss Food	6·50	10·26	4·91	46·43	29·48	2·02	Much cane sugar.
Bananina	9·50	4·10	0·40	84·00		2·07	A banana flour.
Benger's Food	11·29	10·43	1·10	9·90	66·30	0·96	Much digested in preparing.
Carnrick's Soluble Food	5·17	16·69	5·53	28·11	41·50	3·00	Much unchanged starch.
Chapman's Whole Flour	8·40	9·40	2·00	—	79·30	0·90	A wholemeal flour.
Cheltine Infant's Food	7·20	16·20	3·92	71·00		1·83	Contains much starch.
Cheltine Maltose Food	4·60	5·30	0·27	87·60	—	2·25	Fully malted.
Coomb's Malted Food	7·90	12·10	2·80	76·80		0·40	Much unaltered starch.

Cremalto	22·26	6·40	20·26	44·67		1·79	Cream and malt.
Diastased Farina	8·30	7·60	1·30	81·70		1·10	Carbo-hydrates said to be made soluble in preparation.
Fairchild's Milk Powder . . .	5·54	1·19	0·05	92·00	—	1·22	Practically milk sugar.
Falona	7·00	8·40	3·50	79·9		1·20	Cereals and a fat-containing bean.
Frame Food	7·62	13·69	0·44	22·33	54·96	0·96	Not so rich in minerals as claimed to be.
Franco-Swiss Food	4·43	13·00	3·70	46·09	30·86	1·42	Much cane sugar.
Horlick's Malted Milk . . . (ready for use) Chittenden .	2·54 92·40	15·40 1·15	8·87 0·60	69·21 5·38	0·18 —	3·80 0·29	Desiccated milk, 50·0; wheat flour, 26·25; barley malt, 23·00; and sod. bicarb., 0·75.
Horlick's Malted Food . . .	9·70	10·43	0·34	76·83	2·20	—	Almost completely malted.
Hovis Babies' Food	3·70	7·70	0·20	86·60	—	1·82	Fully malted.
Hovis No. 2 Food.	2·40	5·70	0·10	90·10		1·70	Starch 7·5 per cent.
Imperial Granum	11·50	10·91	0·64	5·73	70·22	1·00	—
I. and I. Food.	5·50	10·30	2·30	80·50		1·40	Mainly starch.
John Bull No. 1 Food . . .	3·98	21·00	11·87	54·29	—	5·32	Maltose, 21·32; lactose, 29·42; dextrin, 3·55.
John Bull No. 2 Food . . .	1·68	11·06	0·68	37·65	43·30	1·74	Maltose, 23·31; dextrose, 1·32; dextrin, 5·38; lactose, 7·65.
Kufeke's Infant Food . . .	8·37	13·24	1·69	23·71	50·76	2·23	Made in Germany.
Lahmann's Vegetable Milk . .	24·40	7·50	24·60	41·80		1·50	Made from nuts and can be added to milk.
Loeflund's Cream Emulsion . .	24·32	8·23	15·32	49·43	—	2·60	A thick brown paste made from milk and malted wheat extract.

THE COMPOSITION OF PROPRIETARY FOODS (*continued*).

Name.	Water.	Protein.	Fat.	Carbo-hydrates.		Ash.	Remarks.
				Soluble.	Starch.		
Maltico Food	2·36 1·63	16·07 15·19	11·80 17·19	65·89 63·00		3·88 2·99	Lancet analysis: Composed of milk and malted cereals; no starch.
Manhu Infant Food	8·80	8·70	5·60	75·90		1·00	Desiccated milk and malted cereals; much starch.
Mellin's Food	12·37 6·13 6·30	10·07 7·81 7·90	0·18 0·29 trace	68·18 75·65 82·00	— 6·93 —	3·75 3·17 3·80	Analysis by makers. The other two from other sources. It is a desiccated malt extract from wheat and barley.
Milo Food	3·81	14·34	5·50	58·93	15·39	2·03	Desiccated milk with maltose and dextrins 27·36, and cane sugar 25 per cent.
Moseley's Food	10·84	14·78	1·84	21·76	49·06	1·72	Complete conversion during mixing.
Muffler's Food	4·76 5·63	15·19 14·34	5·10 5·80	72·42 27·41	 44·43	2·43 2·39	Analysis by Stutzer and Richmond. Desiccated milk, powdered white of egg, wheat flour and lactose.
Neaves Food	5·03	13·20	1·70	4·71	74·27	1·09	Practically all starch.
Nichol's Food of Health	11·90	7·70	1·70	76·90		1·75	Mainly starch.
Nutroa Food	6·80	15·90	10·30	66·00		1·00	Cereals *plus* pea-nut flour; hence the fat.
Opmus Food	10·90	9·10	1·00	—	78·60	0·40	A granulated wheat flour.
Ovaltine	3·30	12·01	1·98	76·70	2·57	3·44	A Swiss product.
Phosphatine, Fallières	5·85	2·35	1·92	56·68	31·98	1·22	Calcium phosphate, cane sugar and starch of potato, rice, arrowroot, sago, cocoa.

Ridge's Food	9·23	9·24	0·63	5·19	77·96	0·60	Mainly starch.
Robinson's Groats.	10·40	11·30	1·60	—	75·00	1·70	Ground oats, without husk.
Robinson's Patent Barley . .	10·10	5·13	0·97	4·11	77·76	1·93	Ground pearl barley.
Savory & Moore's Food . . .	5·34 8·34	10·79 9·63	1·06 0·40	27·81 44·83	54·09 36·36	0·91 —	Wheat flour and malt; much grape and cane sugar.
Scott's Oat Flour.	5·80	9·70	5·00	—	78·20	1·30	A fine oat flour. Cf. Groats.
Theinhart's Infantina. . . .	5·03	16·17	5·00	53·61	16·72	3·47	Desiccated milk, diastased cereals, lactose and cane sugar.
Theinhart's Hygiama. . . .	4·75	21·22	10·05	49·10	11·33	3·55	More concentrated and a little cocoa added. The fat is partly cocoa butter.
Triticumina Food.	8·60	12·50	2·20	75·7		1·00	Mainly starch.
Virol	11·66 24·04	6·43 4·16	19·72 10·75	61·61 59·25	— —	0·58 1·80	The first analysis is the one given by the makers.
Well's & Richardson's Food .	7·76	11·85	1·64	39·00	36·43	2·61	Partly malted. Contains much cane sugar and no milk.
Wheat Flour	9·02	7·47	1·01	5·66	76·07	—	—
Wheat flour, baked	7·78	—	0·41	14·29	67·60	—	—
Worth's Perfect Food . . .	2·40	11·10	2·00	83·50		0·50	—

In the above analyses cellulose, gum, etc., are not always included; sometimes they are included under the heading of starch as insoluble carbo-hydrates. The estimation of phosphorus in terms of phosphoric acid is of doubtful value and is not given.

I. FOODS PREPARED FROM COWS' MILK

A. **Condensed milk, without added sugar.**—This may be made from skimmed milk, whole milk, or milk enriched by the addition of cream. The milk is condensed to about one-third of its original bulk.

THE COMPOSITION OF UNSWEETENED CONDENSED MILK.

Brand.	Water.	Protein.	Fat.	Lactose.	Ash.	
Ideal . .	62·00	8·3	12·4	16·00	1·3	—
First Swiss .	62·15	9·9	11·38	14·44	2·1	Average of 4 analyses by skilled analysts.
Peacock . .	64·05	—	10·04	—	1·28	Lancet analysis.
Viking . .	—	8·9	9·9	13·3	—	Chemical and Assay Laboratory.
Hollandia .	57·00	11·3	9·8	18·5	3·4	—

The Ideal brand is stated to be enriched 20 per cent by the addition of cream and is preserved by heat. The Viking brand is said to be made from absolutely pure fresh milk of cows grazed on the Norwegian Highlands. The analysis of the Hollandia milk shows that it is relatively poor in water and made from a milk which was poor in fat.

These foods are valuable for travellers who do not like sugar in tea or coffee or who are debarred sugar. Sometimes they are useful in the treatment of infantile diarrhœa and other alimentary disorders, in which cane sugar is contra-indicated or only permissible in small amount. A dilution with two parts of water makes the mixture like cows' milk. Further dilution and the addition of cream and sugar are essential to make the fluid at all like human milk in percentage composition. It is generally necessary to add sugar in order to get the child to take the mixture. The addition of grape juice to the diet will counteract the evil effects due to the heat used in the preparation of the food.

If no chemical preservative is added, the milk soon turns sour when the tin is opened. This is a serious drawback to its use among the poor. Further, in proper dilution it is a much more expensive food than ordinary cows' milk.

B. **Condensed milk with added cane sugar.**—The bulk of the samples of condensed milk in the market are made from milk, with the addition of large quantities of cane sugar to act as a preservative. The composition is very variable, for the original milk is skimmed milk, whole milk, or milk enriched by the addition of cream. Leeds gives the composition of fifteen varieties and the mean of 41 analyses of a good brand, as :

THE COMPOSITION OF SWEETENED CONDENSED MILK (LEEDS).

	Minimum.	Maximum.	Average.	Mean of 41 Analyses.
Proteins	7·87	10·91	8·82	16·07
Fat	7·64	12·13	8·67	12·10
Milk sugar	10·00	16·98	11·66	16·62
Cane sugar	36·09	42·65	40·39	22·26
Mineral ash	1·82	2·15	1·83	2·61
Milk solids	28·37	36·92	31·71	30·34
Original milk fat	3·06	4·52	3·69	—

The average number of times condensed . . . . 2·27

These results show great variation in composition, but a still more serious defect is present in many samples, namely, a marked deficiency of fat in those made from skimmed milk. An analysis of seventeen samples by Bernard Dyer yielded the following percentages of fat in the various brands examined:

Marguerite	0·42	Wheatsheaf	0·62	Home	1·02
Tea	0·48	Swiss dairy	0·63	Handy	1·49
Gondola	0·48	Daily	0·69	Nutrient	2·36
Cup	0·49	Clipper	0·73	Cow	2·84
Goat	0·56	Shamrock	0·79	As you like it	4·23
Calf	0·60	Cross	0·96		

Such brands as these may be useful as food, for culinary purposes, and for addition to tea, etc., but should certainly never be given for infants, unless it is temporarily advisable to omit fat from the diet.

Some of the best sweetened condensed milks are Nestlé's and the Anglo-Swiss Milkmaid brand, made both in England and Switzerland. Since the amalgamation of the companies making these brands, the Milkmaid Swiss and Nestlé's Swiss milks have a similar composition, differing a little from that made in England. They are prepared under most careful supervision from whole milk, which is obtained fresh from local inspected farms, under stringent regulations as to proper cooling of the milk and general cleanliness. The sugar added is the purest obtainable and is still further purified at the factory to get rid of any dirt present. All the processes of condensation and tinning are carried out in the best possible manner, and in every respect these varieties are excellent specimens of condensed milk. There are other good brands. One of them, the Peacock brand, should be mentioned, for it contains only about half the amount of cane sugar usually added. The protein, lactose and cane sugar amount to a total of 43·32 per cent (*Lancet*). Peacock condensed milk is made from whole milk and skimmed milk, so the two kinds must not be confused.

THE COMPOSITION OF SWEETENED CONDENSED MILKS.

	Total Solids.	Protein.	Fat.	Lactose.	Sucrose.	Ash.
Nestlé's.	73·7	9·7	11·5	13·0	37·5	1·9
Milkmaid (S) . . .	73·7	9·7	11·5	13·0	37·5	1·9
,, (E) . . .	75·5	9·6	10·1	12·5	41·5	1·9
Rose	76·3	9·7	11·0	14·6	38·7	2·3
Full Weight . . .	76·5	12·3	11·0	13·5	37·2	2·5
Anglo-Swiss . . .	74·4	8·8	10·8	16·0	37·1	1·7
Peacock	63·3	—	10·0	—	—	2·0

(S) Made in Switzerland. (E) Made in England.

Humanized condensed milk is prepared by the addition of cream and lactose, before condensation, in such quantities as to form a solution, when suitably diluted, equivalent to human milk in percentage composition.

The composition of condensed milk shows that it is a valuable article of diet. For adults and children beyond the period of infancy it is a safe and useful food, provided plenty of fat is obtained from other sources. It is, however, in its wide use as a food for infants, in the place of the maternal milk or the fresh milk of some other animal, that it causes widespread injury and deserves most serious criticism.

The analyses of the best brands show that condensed milk, in the ordinary dilutions made use of, is grossly deficient in fat. If diluted beyond one part in eight, it will also be deficient in protein and sugar, when compared with average human milk. And it is not a fresh food. It is generally much too diluted, forming a weak sugary solution, deficient in fat and protein. The weakness of the mixture is to some extent compensated by the greater quantity taken, and its easy digestibility and absorption. The digestibility is partly due to the weakness of the fluid and partly to the action of the heat on the casein, which is rendered uncoagulable by rennet. Its wide popularity among the poor is due to the ease with which the baby's meal is prepared. The milk is less liable to go sour than cows' milk which, in addition, is difficult to obtain fresh and clean. Cows' milk causes more trouble in preparing each feed, and the curd is difficult to digest and liable to set up vomiting, colic or diarrhœa. The baby usually likes the sugary fluid, takes it well, digests it, is satisfied, and grows fat. The evil effects develop slowly, as a rule, and are not recognized as due to the diet, being more readily ascribed to vaccination, the bite of a dog, or some such cause.

An infant fed on condensed milk becomes anæmic, fat and lethargic. The deficiency of protein, and the alterations produced in it by heat, lead to weakness and flabbiness from the impoverishment of the blood and impaired nutrition of the muscles. The excess of sugar causes a deposition of fat and is liable to set up intestinal derangements from fermentative changes. The deficiency of fat, in addition to other defects in the food, causes rickets. It is extremely rare for a babe fed on condensed milk not to develop some degree of rickets. Frequently the disease supervenes in a severe form. Further, the child, though large and fat, is far from strong and has little vital resistance to intercurrent disease, such as attacks of bronchitis or gastro-intestinal derangements, to which these infants are peculiarly liable. Another danger is the appearance of scurvy, for the milk is deprived of its anti-scorbutic properties by the heat used in condensing it. The alterations in the salts, due to heat, have probably a deleterious effect on metabolism and nutrition.

Although the milk is condensed at a high temperature it is not invariably sterile. Cultivation experiments have frequently demonstrated the presence of micro-organisms. It will keep remarkably well in the unopened tin, but after a time is liable to decompose. It may become slimy, cheesy, or semi-solid. It may become quite solid or "go hard." It may undergo putrefaction, in which case the tin becomes "blown." Any of these changes renders it an unsuitable food, especially for babies. Needless to say, the people who commonly use it are the ones least likely to pay attention to these changes or notice any alteration in the taste or smell. Although the sweetened variety keeps better than the unsweetened, when the tin has been opened, it will decompose pretty rapidly in hot weather unless ice or a refrigerator is available. Furthermore, condensed milk is more expensive than ordinary fresh cows' milk, diluted and sweetened, if it is given in a solution of equivalent strength or in the proportions appropriate for infant feeding.

It is a valuable substitute for cows' milk when travelling, in very hot weather, and when good cows' milk is not available. In many marasmic conditions and in some affections of the alimentary tract it is also useful. Given under medical advice and as a temporary expedient, there is nothing to be said against its use. One may go further and state that it is quite possible to bring up a baby perfectly satisfactorily on condensed milk, provided that extra fat is given in the form of cod-liver oil or olive oil, extra protein in the form of egg albumin, and fruit juice to counteract the tendency to scurvy due to a prolonged diet of cooked food. I have obtained extraordinarily good results in some instances by feeding infants on one or other variety of condensed milk, when all other methods of artificial feeding have failed and a wet-nurse has not been available. Unfortunately it is the abuse of this method of feeding which has rendered condensed milk obnoxious to the medical profession. Nevertheless, it must be candidly admitted that there are many cases in which a diet of condensed milk is infinitely superior to ordinary cows' milk, notably so in hot weather, among the poorer classes, and in some cases of marasmus. The difficulties which the poor have to contend with in obtaining fresh, clean, pure milk, and in keeping it in their insanitary, stuffy, crowded tenements, often render condensed milk a much less dangerous diet for a baby than cows' milk. The nutritive value depends on the quality of the original milk, the degree of condensation, the addition of cream (if any) and the amount of cane sugar added. Of the different varieties the sweetened ones are the best for infant feeding, and only the best brands should be used. The unsweetened should only be used under medical advice. Those which are made from skimmed milk should only be given when specially ordered, but may be used as a cheap substitute for milk for adults and children who get plenty of fat and protein in other forms. The value of separated milk is not nearly sufficiently realized. It is a rich nitrogenous food and contains lactose, whether fresh or condensed, but there is practically no fat in it.

C. **Dried milk preparations.**—A large number of preparations of dried milk are now obtainable. Some of them are preparations of pure casein; some are derived from separated milk, and contain a little fat and more or less sugar; some are derived from whole milk; and others are in the form of milk powders, composed of milk modified by abstraction of casein or addition of sugar, or both.

COMPARATIVE ANALYSES OF DRIED MILK PREPARATIONS.

	Protein.	Fat.	Other Substances.	Salts.	Water.
Biogene[1]	78·75	1·58	4·04 (organic)	4·73	10·00
Casumen[2]	86·47	3·60	—	2·93	7·00
Lacvitum[1]	28·04	29·40	31·26 (lactose)	5·96	5·34
Lacumen[1]	40·00	—	—	—	—
Plasmon[1]	80·00	Traces	—	7·00	10·5
Protene	80·00	—	—	—	—
Tilia	76·37	0·17	5·70	9·25	8·51

Biogene is a soluble, tasteless, odourless casein, free from starch and sugar. *Prideaux's Casumen* (2*s*. per lb.) is a white, flake-like powder, odourless, tasteless, soluble, and miscible with ordinary foods and drinks. The salts consist of phosphates of calcium and potassium 1·92, and salts of sodium 1·01. It

[1] Analysis given by the makers. [2] Analysis by *The Lancet*.

is free from starch and sugar and keeps indefinitely. It is combined with other foods in the form of arrowroot, chocolate, cocoa, cornflour, biscuits, bread and macaroni. A diabetic milk can be made from it by the addition of water, a weak alkali, and saccharin. *Plasmon* is almost identical with casumen, practically free from fat and sugar. It is a white, finely granular, odourless, tasteless powder, rendered soluble by the addition of bicarbonate of soda, miscible with ordinary foods and drinks, and useful for rectal feeding. It is combined with other foods in the form of arrowroot, chocolate, cocoa, biscuits, beef, tea, oats, etc. *Protene* is almost identical with plasmon. *Tilia* is also practically pure casein, which mixes with water and forms an almost transparent and tasteless solution. It contains 11·97 per cent of nitrogen and 1·83 per cent of phosphoric anhydride.

Casein is combined with ammonia under the name of *Eucasin*; with sodium, as *Nutrose*; with 5 per cent of sodium glycerophosphate, as *Sanatogen*; and with 20 per cent of albumose, made from egg albumin, as *Sanose*.

Desiccated whole milk is sold under the names of *Glaxo* (Nathan and Co.); and *Lacvitum* (Prideaux) at 1*s*. to 1*s*. 3*d*. per lb. The latter company provide *Laeumen*, at 5*d*. to 9*d*. per lb., the desiccated product of skimmed milk; and another powder made from a milk deprived of half its fat.

Dried casein is a very nutritious food, on a par with cheese made from skimmed milk. It is enormously valuable in that it can be added to other foods, thus improving their protein value. The casein is purin-free, does not clot, and is easily digested and absorbed. It is indicated in all affections in which additional protein is needed, and is useful as a means of giving phosphorus in organic combinations. It is especially valuable in the treatment of acid dyspepsia, for the protein fixes the acid. Protene and plasmon arrowroot are beneficial in the treatment of diarrhoea.

Allenbury No. 1 *Food* may be classed in this group. It is a dry powder, made from cows' milk from which the excess of casein has been removed and the deficiency in fat and sugar corrected. It is free from starch and is often very useful as a temporary food for infants in the first three months of life.

D. **Predigested or peptonized milk.**—It is advisable that milk of this nature should be made at home by means of the Allenbury peptonizing powders, Fairchild's zymine powders, or Fairchild's peptogenic milk powder, which is chiefly composed of milk sugar (*vide* table of analyses). Such milk can be bought ready made from some of the larger milk companies. Other predigested varieties are sold under the name of *Loeflund's peptonized milk* and *Backhaus's milk.* Some of the so-called humanized milks are prepared by partial peptonization or pancreatisation of the milk proteins. *Savory and Moore* supply a condensed peptonized milk.

E. **Modified milk.**—Various companies and municipal bodies are supplying, for the use of infants, milk which is simply pasteurised or sterilised, or is modified in the relative percentages of its component parts before being heated. The *Paget's Milk Food* Company supply a milk which has a percentage composition, when diluted with one to two parts of water, of :—

Protein, 1·33–2·0 ; fats, 2·5–4·0 ; lactose, 5·0–7·0 ; salts, 0·27. Apparently a considerable amount of the casein is removed from the original milk, for the food hardly clots with rennet. Various preparations are sold under the name of *Facsimile Human Milk.* Sometimes this is a complete misnomer. At others it has a certain amount of justification in that the composition more or less approximates to that of human milk. *Frankland's Artificial Human Milk* is made by adding cream and whey to whole milk, and this is the basis of many trade preparations sold as humanized milk. Milk is also modified by the reduction in the amount of casein and the addition of lact-albumin and albumoses or peptones. *Somatose Milk* and *Rieth's Albumose Milk* are of this nature.

II. COWS' MILK WITH CARBO-HYDRATE (CEREAL) ADDITIONS

A. **The starch practically unchanged.**—e.g. Anglo-Swiss, American-Swiss, and Franco-Swiss foods. These all appear to be made from condensed milk, baked wheat flour, and sugar.

Analysis shows them rich in starch and cane sugar, and deficient in fat and protein. Possibly the gluten of the flour is rendered somewhat more digestible in the process of preparation. These foods are unsuitable for infants under the age of six months, because of the high percentage of starch and deficient fat. After this age they are quite unnecessary, for the child should be able to take fresh cows' milk, to which starch can be added in the form of a cereal decoction, and sugar if required. *Muffler's Food,* sold by the Aylesbury Dairy Company at 1*s.* 6*d.* a bottle, is very much the same and not much more valuable. It is composed of desiccated milk, powdered white of egg, wheaten flour and lactose, and contains very little fat.

B. **The starch partly or entirely converted into soluble carbohydrates.**—e.g. Allenbury No. 2 Food, a combination of the No. 1 Food with a malted meal; Horlick's Malted Milk; John Bull No. 1 Food; Loeflund's Cream Emulsion; Maltico; Manhu Infant Food; Milo Food; Theinhart's Infantina and Hygiama. The composition of these foods is given in the table of analyses, and reference thereto will show which contain the least unconverted starch. On the whole, if a mixture of condensed milk and a malted flour is desired, reliance can be placed on those foods in which there is little unchanged starch. The functions of starch digestion can be trained by gradually changing to foods which contain a higher proportion of starch. As infant foods these possess all the disadvantages of condensed milks, in respect of lack of freshness and deficiency of fat. The main difference lies in the character of the soluble carbo-hydrates present, in place of an excess of cane sugar.

C. **The milk partially predigested, or the food containing ferments which act on the protein of the milk and the starch in the food during the process of preparation.**—Benger's Food and Carnrick's Soluble Food are of this type. *Benger's Food* is, in my opinion, the most valuable proprietary food on the market. It consists of a wheaten meal, cooked and impregnated with a suitable proportion of the natural digestive ferments of the pancreas. On mixing the food with warm milk, the ferments convert the carbo-hydrates into soluble dextrins and sugars, and partially peptonize the proteins. The fat is not changed.

The main objections are that the amount of predigestion of the starch cannot be accurately determined or regulated, and that a considerable amount of starch is unchanged. These are not serious drawbacks when the food is used under medical advice. The food is especially valuable for marasmic infants over six months of age, and it may be given with advantage, if cautiously watched, to much younger infants who cannot digest ordinary cows' milk. The addition of half a teaspoonful to a couple of ounces each of milk and water for a child of three or four months is sometimes most beneficial. It is useful also for other young animals, such as puppies and kittens. It is a valuable food in typhoid fever, gastric and intestinal troubles, anorexia from any cause, convalescence from acute illness and in malnutrition generally. Given in the form of thick gruel at bedtime it has a remarkably fattening effect, and should not be allowed for middle aged or old people with a tendency to obesity.

Carnrick's Soluble Food consists of desiccated milk 37·5, malted wheat flour 37·5, and milk sugar 25·0 per cent. In the process of preparation the casein is partially digested by extract of pancreas, but much starch remains unchanged. It is greatly inferior to Benger's Food in that it is not prepared with fresh milk.

III. CARBO-HYDRATE FOODS

A. **Practically unchanged starch.**—Many of these foods are made from wheat flour or mixed flours which are practically unchanged. Some are said to be baked, but the effect of baking is very slight. Baked flour only differs from ordinary flour in containing a small amount of soluble carbo-hydrates, due to the action of the heat on the starch. Perhaps the heat renders the starch granules more susceptible to the action of digestive juices and diastasic ferments. The chief foods of this nature are: Albany, Chapman's Whole Flour, Imperial Granum, Neaves, Ridge's, Opmus, Robinson's Patent Barley, Robinson's Groats, Scott's Oat Flour, Hovis Oats, Quaker Oats, etc.

Falona is composed of well-baked cereals and a bean flour containing fat in small amount. *Nutroa* is made from cereals and a peanut flour containing fat. It is richer in fat than Falona is, and the starch is said to be partly converted in mixing. *Frame Food* is a mixture of baked flour, sugar, and an extract derived from the bran of wheat. According to the makers the extract contains albuminoids, 22·0; phosphates, 10·5; carbo-hydrates, 58·0; water, 9·5. These foods are only suitable, except in extremely weak decoctions, for infants who are well able to digest starch, for older children and adults.

B. **Partially malted foods.**—The starch is partly converted into dextrins, maltose and dextrose. In foods such as I. and I. Food, Nichol's Food of Health, Triticumina and Worth's Perfect Food, the starch is not much changed. In others considerable conversion has taken place and more is changed in the process of preparation, e.g. Allenbury No. 3, Cheltine Infant's Food, Coombs Malted Food, Hovis Babies' Food No. 2, John Bull No. 2, Kufeke's Infant Food, and Moseley's Food. *Phosphatine Fallières* is of a similar nature. It consists of the starch of potato, rice, arrowroot, sago and cocoa, with the addition of cane sugar and calcium phosphate. Perhaps it would be better to place it in the previous group, because of the small amount of soluble carbo-hydrates, apart from cane sugar.

C. **Completely malted foods.**—The best of these are Mellin's, Horlick's, and Paget's Malted Farina. Others of a like nature are the Cheltine Maltose Food, Diastased Farina, Hovis Babies' Food No. 1, and Racia. Some of the partly malted foods are said to be completely changed during mixing and, if so, might be included in this group, e.g. Coombs malted food, Moseley's food, and Nutroa.

D. **Malt extracts** are malt infusions evaporated down *in vacuo*, at a low temperature in order to preserve the diastasic ferment. This ferment is of doubtful value, and the expense of preparation of these extracts could be greatly reduced if they were made at a higher temperature and the ferment destroyed. Klemperer gives the average percentage composition of malt extracts as: protein, 5–6; sugar, 50–55; soluble starch, 10–15; ash, 1–2; water 22–34. In the desiccated malt extracts all the water is removed; e.g. *Curtis's Desiccated Malt Extract* and *Gramalt* (Christy and Co). *Hoff's Malt Extract* is a liquid preparation, with the taste and smell of beer. It does not mix well with cod-liver oil, making a gruesome mixture which is unpleasant to take. The oil mixes well with maltine, especially the thick treacly kinds such as Kepler's Malt Extract. *Maltova* is a mixture of malt and eggs, with no special advantages over maltine and eggs taken separately.

IV. NITROGENOUS FOODS

(1) **Foods prepared from meat** are sold under the name of meat teas, meat extracts, meat juices, peptones and peptonoids, and dried meat powders. Some are supposed to have marvellous nutritive value because of the evaporation of a watery extract of the meat, or of the juice expressed from meat, into a fluid which is stated to contain the nutritive elements of the original muscle fibre in a concentrated form. Others base their claims on the predigestion of the protein before concentration. It is not invariably true that these preparations are made from meat. The absence of creatinin, in some specimens, suggests that these particular ones are purely artificial products.

Analyses of various meats show that the average percentage of protein is about 20 and that it is, therefore, impossible to concentrate meat down to less than a fifth of its bulk, if the total nutritive value of the protein is to be retained. Reference to the tables of analyses of these nitrogenous foods shows that in few instances does the percentage of protein equal that of the original meat from which the food is made, while in many it is very considerably less, even if undiluted. In those cases in which the percentage of protein is high, the food is usually given diluted with a large quantity of water.

The high percentage of extractives in many of these preparations proves that they are fluid extracts of meat. These extractives are of no nutritive value, throw an extra strain on the liver and kidneys, and are probably actively injurious. The high proportion of salts and extractives leads to thirst and diarrhœa, if these foods are given in large quantities.

A. In the ordinary process of making beef tea and clear soups the product is strained and the protein, coagulated by heat, which forms the nutritious sediment, deprived of its stimulating taste, is usually thrown away. A weak gelatinous fluid is left which is converted into a firm jelly on cooling, if the gelatin amounts to one per cent. **Beef tea** is often made in institutions from some one or other of the various meat extracts, instead of from fresh meat, so it is worth while to consider the nutritive value and the expense of these different preparations.

APPROXIMATE COMPOSITION OF BEEF TEA PREPARATIONS.

	Water.	Proteins.	Extractives.	Mineral Ash.
Mason's—strong beef tea	89·02	6·86	2·47	1·65
Bovril Co.—Vril, albuminous beef tea	84·00	10·17	4·17	1·66
Brand's—fibrous beef tea	83·21	11·40	4·52	0·86

According to the *Lancet* analysis Mason's beef tea contains meat fibre 3·74 per cent, soluble albuminoids and extractives 10·58, mineral salts 2·37.

A comparison of the above preparations with beef tea, as ordinarily made, is distinctly to their advantage. Home made beef tea contains about 1·5 per cent of protein and, if made by the boiling process, may contain considerably less. An analysis of a sample of that made at St. Thomas's Hospital yielded the following results (*The Hospital*, June 11, 1904) :—

Water	96·030
Fat	0·199
Insoluble protein and meat fibre	0·208
Soluble proteins and gelatin	1·342
Meat bases	0·608
Non-nitrogenous extractive matters	0·843
Mineral matters	0·770

The total dry solids amounted to 3·97 per cent and of that 1·55 per cent only, inclusive of gelatin, was of value as food.

The price of beef tea made from various foods is given in the following table (*The Hospital*, June 1, 1907) :—

Name of Food.	Price.	Amount Required.	Cost per Pint.
Lemco	5s. 6d. per lb.	1 lb. for 60 pints	1d. and a fraction
Ramornie[1] . . .	5s. ,,	1 oz. ,, 3 ,,	Ditto
Oxo	3s. 9d. ,,	1 lb. ,, 22 ,,	2d.
Nursing Oxo[2] . .	4s. ,,	1 lb. ,, 22 ,,	2⅕d.
Invalid Bovril . .	4s. 6d. ,,	3 oz. ,, 4 ,,	2¼d.
Mason's beef tea .	—	—	3½d.
Brand's beef tea .	10d. ,,	3 lb. ,, 7 ,,	4¼d.
Oxvil	—	—	5d.
Foreign meat . .	2d.–3d. ,,	—	1½d.–2d.

These results are based on institutional prices. The price per pint is not an absolute criterion of the value, unless we regard these preparations as of such little use for nutritive purposes that the actual percentages of protein can be neglected. Probably this is true, for the amount of protein which can be taken in this form is really remarkably small.

These foods may be restorative and stimulant, but they are certainly only feebly nutritive and are an expensive form of diet. Probably the use of beef tea and meat extracts depends on the fact that in digestive disorders and in fevers, in which digestion is impaired, the appetite is bad, and the tongue furred, the patient dislikes food, but can take a hot, clean, non-cloying fluid which by virtue of the heat has some stimulating properties. Put plainly, the patient is better without food, and really derives benefit from the comparative starvation and not from the constituents of the extract which he is induced to swallow. These preparations have a great influence on the minds of the patient and friends, who are apt to dread abstinence from food as a source of extreme danger and have an abounding faith in the nutritive value of beef teas, jellies and meat extracts. As a food milk is infinitely superior. There is one advantage in these foods which must not be overlooked. They encourage appetite and the secretion of gastric juice. A few tablespoonfuls of clear soup or of a diluted meat extract, taken at the beginning of dinner or just beforehand, will improve

[1] Liebig's Extract of Meat as prepared by the Australian Meat Co.
[2] Peptonized.

both appetite and digestion. A large amount may be harmful by unduly diluting the gastric juice. They may be regarded as concentrated flavouring substances of meat the nutritive matters being extracted. Liebig's Extract was the first and remains the most typical of these meat extracts. As originally made it is practically free from protein and fat. It is a concentrated watery extract of meat, heated under pressure, filtered and evaporated.

THE APPROXIMATE COMPOSITION OF MEAT EXTRACTS.

	Water.	Proteins and Gelatin	Extractives.	N.-free Substances etc.	Mineral Ash.	References and Remarks.
Armour's Extract[1]	24·30 15·55	16·08 10·89	20·55 43·23	20·06 4·12[2]	19·03 25·91	*Food and Sanitation*, 1893
Bovril . . .	44·40 39·58	16·94 9·12	20·32 34·10	— 1·29[2]	18·32 13·52	Stützer, 1897 Chittenden
Bovril Fluid Beef[1]	38·10	12·24	12·04	19·75	17·87	—
Invalids' Bovril[1]	21·82 21·16	21·42 16·66	39·60 16·13	— 29·23	17·16 16·82	— Allen's commercial analysis
Bouillon Fleet .	61·95	11·81	9·87	3·87	12·50	Tatlock
Brand's Beef Bouillon[1]	36·27	9·58	19·34	19·75	15·07	—
Brand's Essence.	87·17	10·43[3]	1·01	—	1·39	Candy, *vide* Hutchison, 1904. The juice of beef, mutton, veal or chicken, without any addition
Hipi	42·00	43·00[4]	—	6·60	8·40	*Medical Press*, 1899. A mutton extract
Lemco[1] . . .	17·80	16·48	38·12	6·00	21·50	—
Liebig's Extract	20·06 18·30	0·06 9·40	55·72 30·00	0·91[2] 18·60[2]	24·04 23·60	Chittenden. Fat and protein free. Tankard
Mason's Essence	77·07	3·03	7·47	2·92	9·51	*Food and Sanitation*, 1896 (Hehner)
Oxine Extract[1] .	62·90	13·00	4·54	—	19·60	Hutchison
Oxo[1] . . .	38·10	18·93	20·31	5·35	17·31	Meat extract, albumin and fibrin, without fat
Viking Beef Essence	90·68	3·63	1·85	2·41	1·43	Tankard

[1] Analysis given by the manufacturers.
[2] Ether extract.
[3] Half gelatin.
[4] Including extractives.

According to Liebig 34 lb. of beef should yield 1 lb. of extract, which should contain extractives 56–60 per cent, salts 18–24 per cent and water. It should be practically free from fat, protein and gelatin. Gelatin is sometimes added. It would be a valuable food if the extractives were tissue builders, energy producers or stimulants. As energy producers they are practically valueless, though some undergo further oxidation. They are certainly not tissue builders, and they are not true stimulants, either of the circulation or the nervous system. Modifications of Liebig's process were soon introduced, when it was recognized that the fluid had no nutritive value. Most of these modifications depend on the addition of some of the meat fibre which is previously separated. The meat fibre is in the form of insoluble protein. Although it is present in *Bovril Fluid Beef* and *Bovril for Invalids* to the extent of 8–9 per cent, the total percentage of protein and gelatin is, according to some analyses, less than that of fresh beef. The comparative analyses of dried meat, dried bovril and a yeast extract, called *Marmite*, must be noted, for the latter resembles meat extract and has been used in its adulteration.

	Proteins.	Extractives.	Ash.	Water.	Organic Matter.	Reference.
Dried meat . . .	86·70	7·80	5·3	5·4	94·6	Voit
Dried Bovril. . .	49·70	25·60	24·7	24·7	75·3	Voit
Marmite (1) . . .	4·10	46·90	18·9	30·1	69·9	Hutchison
„ (2) . . .	10·50	34·67	26·95	26·84	73·16	Makers

B. **Meat Juices** differ from meat extracts in that they are supposed to consist of the blood and fluid substances obtained by compression of the muscle fibres. Strong pressure is used to extract the juice which is subsequently concentrated by evaporation *in vacuo*. Heat must be avoided for it coagulates the protein. Hence the process is an expensive one and the product is liable to decomposition, unless preserved by the addition of glycerine, salt or some chemical preservative.

Many of these foods form a red solution on adding water, look like blood and are consequently repugnant. Some give the spectrum of hæmoglobin. *Bovinine* appears to be a mixture of blood and glycerine, and gives the spectrum of methæmoglobin. There is considerable doubt as to the absorbability and nutritive value of hæmoglobin. *Puro* depends for its nutritive value on egg albumin. If such a food is required, it is simpler and cheaper to take the white of egg and flavour with meat extract or home made beef tea. *Valentine's Meat Juice* is the most expensive and, according to Chittenden's analysis, the least nutritious of these foods on the market.

The composition of the various meat juices is shown in the table of analyses. The nutritive value of each depends on the amount of protein and varies enormously.

THE APPROXIMATE COMPOSITION OF BEEF JUICES.

	Water.	Proteins and Gelatin	Extractives.	N.-free Substances	Mineral Ash.	References and Remarks.
Armour's Beef Juice.	74·10	8·30	9·54	—	7·51	Attfield
Armour's Soluble Beef[1]	23·07	33·38[2]	13·44	6·75	13·27	—
Bovinine	81·09 78·42	13·98 13·32	3·40 0·55	— 6·01	1·02 1·60	Chittenden Hehner
Bovril Beef Juice[1] .	52·01	7·23	14·03	20·76[3]	5·97	—
Brand's Meat Juice .	59·15	15·45[4]	16·55	—	8·85	No chemical preservatives
Burgoyne's Meat Juice	49·51	13·00[5]	8·10	—	14·20	Candy
Esco Beef Juice . .	52·43	7·60	5·90	13·62	20·39	Tankard
Lipton's Fluid Beef .	42·91	22·13[6]	18·70	—	16·26	*Lancet*, 1898
Liquor Carnis[1] . .	56·06	6·96	5·01	28·42	3·55	—
Puro	36·60	30·33	19·16	—	9·79	Leyden's *Handbuch.* Contains much egg albumin
Valentine's Beef Juice	60·31 51·21	0·55 9·65[7]	29·15 11·16	— —	11·30 10·84	Chittenden Candy
Vitalia Meat Juice .	66·50	21·00	6·00	—	6·50	*Lancet*, 1895
Wyeth's Meat Juice .	44·87	38·01[8]	—	—	17·12	*Lancet*

[1] Analysis given by manufacturers.
[2] 32·05 soluble.
[3] Carbohydrates.
[4] 5·28 coagulable.
[5] 3·71 coagulable.
[6] 6·87 coagulable.
[7] 0·53 coagulable.
[8] Including extractives.

Other preparations.—*Curtis's Meat Juice*, prepared from fresh beef by the cold process and supplied in glass bottles, contains hæmoglobin, 2·3 per cent of coagulable albumen, 6·54 per cent of mineral matter, and 63·53 per cent of water. *Vinsip* is made of blood, boric acid and a little alcohol, and contains 16 per cent of protein. Alcoholic compounds of meat extracts must be severely condemned, even if enriched by addition of maltose or other sugars. They are very apt to set up the alcoholic habit.

Fresh meat juice is cheaper than these preparations and more valuable by reason of its freshness and its composition. From broiled rump steak, slowly pressed, a fluid can be obtained which contains from 5–7 per cent of protein. It contains a relatively small quantity of extractives, and can be given in considerable amounts without causing either diarrhœa or thirst. If the meat is minced, covered with about half its weight of water, allowed to stand for a few hours, and then squeezed through muslin, a fluid is obtained which contains from 2–4 per cent of protein. Meat juice can be given mixed with beef tea or in a coloured glass to hide the colour. The proprietary meat juices should be supplied in glass bottles or porcelain jars, and not in tins, for some of the tin may be dissolved out and cause symptoms of poisoning.

C. **Predigested meat foods** are generally sold under the name of peptones, fluid meat, or peptonoids. They usually contain more albumoses than peptones. The value of predigestion, partial or entire, has already been referred to. In the case of meat foods one great disadvantage is the tendency to induce diarrhœa, due to the albumoses and peptones. The amount of soluble protein varies greatly in the different foods, from only 3 per cent in Armour's Wine of Peptone to 80 per cent in Somatose. The next table gives the composition of these foods.

THE APPROXIMATE COMPOSITION OF PEPTONE PREPARATIONS.

	Water.	Insoluble Proteins.	Peptones.	Albumoses.	Extractives and other Substances	Mineral Ash.	References.
Antweiler's Peptone	6·92	3·22	60·15	14·54	1·74	13·31	König
Armour's Wine of Peptone	83·00	—	3·00		12·90	1·10	Hutchison
Benger's Peptonized Beef Jelly	89·68	—	4·75	2·41	2·27	0·89	König
Brand's Beef Peptone	84·60	—	7·00		—	1·40	Hutchison
Carnrick's Liquid Peptonoids	5·40	—	24·00		65·40 (sugar chiefly)	5·20	—
Carnrick's Peptonoids	2·13	12·22	0·88	3·17	77·03	4·57	—
Darby's Fluid Meat	25·71	—	30·60	—	30·18	13·50	Leyden's *Handbuch*; König; Horton Smith, *Journal of Physiol.*, 1891
Denaeyer's Peptone	78·45	—	12·15		4·32	2·54	Leyden's *Handbuch* and Von Noorden
Fairchild's Panopepton	81·00	—	3·00		15·00 (sugar chiefly)	1·00	Hutchison
Kemmerich's Meat Peptone	33·30	1·10	32·57	14·56	10·27	7·73	König
Koch's Meat Peptone	40·16	1·42	18·83	15·95	16·75	6·89	König
Liebig's Peptone	31·90	—	33·40		24·60	9·90	Leyden's *Handbuch*
Mosquera Beef Meal	—	48·00	29·00		13·00 (Fat)	—	—
Savory & Moore's Fluid Beef	27·01	—	2·74	5·42	52·73	12·10	König
Somatose . .	14·25 9·20	— —	62·25 80·00		2·62 —	5·30 6·70	Tankard
Valentine's Meat Juice	59·07	—	4·87	1·81	22·73	11·52	—

Other peptone preparations may be mentioned:

Gerrard's Liquid Peptone: a predigested protein and carbo-hydrate mixture, made from whole meat, malt peptone and detannated wine. *Leube-Rosenthal Meat Solution*: a preparation of meat which has been partially digested by hydrochloric acid, pounded up in a mortar, neutralized by alkali, and mixed with water to the consistency of a thin paste. It looks and tastes like salt cooked meat. Containing albumin 11·0 per cent, peptone 6·5, and fat 6·0, it is nearly as nutritious as and is more digestible than ordinary meat. *Ju-Vis*: a mixture of vegetables and meat extract. Its composition is given as water, 28·8; albumin, 1·10; peptone, 4·76; albumose, 9·92; nitrogenous bases, 20·63; non-nitrogenous matter, 9·37; mineral ash, 25·42. Ju-Vis Tablets are composed of extract of meat, gelatin, and Ju-Vis extract. One is sufficient to make a cup of beef tea, obviously of small nutritive value. *Sanose*: a preparation of casein 80 per cent and albumose 20 per cent, from white of egg. *Brand's* peptone preparations are made from beef, mutton, veal and chicken. *Carnrick's Liquid Peptonoids* are made from beef, wheat and milk. The manufacturers have recently stated that the total protein amounts to 6·89 per cent, of which 4·62 per cent is pure peptone. Their peptonoids contain meat bases, 2·87; fat, 2·00; lactose, 48·52; and starch, 23·64. The *Mosquera Beef Meal* is a meat which is partially digested by the ferment of pine-apple juice. *Savory and Moore's Fluid Beef* contains little peptone. Ordinary peptonized milk yields about 1·75 per cent of peptone, a sufficient amount for clinical purposes. *Somatose* is a grey powder, made from meat, soluble in water and almost devoid of taste and smell. A milk somatose is made from milk, with the addition of 5 per cent tannic acid; dose one to four drachms daily. Apart from the liability to cause diarrhœa, the possible weakening of the digestive functions from disuse, and the cost, these foods are unnecessary. If simple proteins, such as white of egg, dried casein foods, fresh meat or dried meat powders cannot be digested, then recourse may be had to the various forms of predigested foods which can be made at home from fresh food-stuffs, by the aid of peptonizing powders and pancreatic extracts.

D. **Dried meat powders** can be made at home by mincing cold boiled beef, drying it thoroughly in a slow oven, and grinding it up in a coffee-mill. Or it can be bought in the form of Meatox, Brand's Nutrient Powder, or a powder made by M'Call of London, containing 12 per cent of moisture and flavoured with salt and pepper. The composition of *Meatox* is: water, 5·0; proteins, 73·8; fat, 12·1; extractives, 7·7; salts, 2·0. It is a powdered beef, without preservatives. Meat powders can be added to other foods. Egg albumin is usually better. Dried casein foods are cheaper and purin-free. Powdered pulses are rich in protein.

Meat lozenges, beef tea tabloids, and combinations of meat extracts with other food-stuffs are to be absolutely condemned. Such lozenges and tabloids are quite innutritious and are practically concentrated salts and extractives.

(2) **Fish foods** are not plentiful. *Marvis* is a dried fish powder, made in Greenock N.B. from white fish, and mainly protein.

(3) **Vegetable protein** is sold in the form of *Aleurone*, a colourless, odourless, tasteless, fairly soluble powder, from the protein of wheat; or as *Aleuronat*, a yellowish-brown powder, almost insoluble in water, containing 80–90 per cent of protein. *Legumin*, or vegetable casein, is made from pulses; *Plantose*, from rape seed; and *Roborat* from cereals. Roborat contains 83 per cent plantose, is tasteless, the most soluble and the best. Marmite, Falona and Nutroa have already been referred to.

(4) *Tropon* is derived from **waste vegetable and animal food**, chiefly from fish and cheap vegetables. It is not very soluble and has a rather sandy taste. *Vegox* is a compound of essence of beef and vegetables, containing water 42·8, extractives 49·4, fibre and vegetable matter 7·8 (Hutchison).

V. Fat foods.—Substitutes for cod-liver oil are sold: e.g. *Pilchard Oil*; *Cotton Seed Oil* with 6 per cent oleic acid; *Lipanin*, olive oil with 6 per cent oleic acid; and various cod-liver oil emulsions, containing one or more of the constituents, mucilage, alkali, glycerin, and malt extract. *Pancreatic Emulsion* is a mixture of emulsified lard, pigs' pancreas and oil of cloves.

Petroleum Emulsions are also sold. They merely act as lubricants, for petroleum is a hydrocarbon, not a fat, and is not absorbed.

A study of the composition of the various proprietary foods shows that some may be regarded as more or less pure foods, while others are combinations of fat and protein, fat and carbohydrate, protein and carbo-hydrate, or all three constituents.

VI. Combination foods.—*Pemmican* is a good instance of fat and protein in combination. It is the dried product of the best beef and fat, 50 parts of the former to 40 of the latter, and is most nutritious. *Everton Toffee* is a fat and carbo-hydrate food: so, too, is *Chocolate*, containing fat 20, and carbo-hydrate 50 per cent, but it is hardly a proprietary food. *Cremalto* is a mixture of Devonshire cream and malt. *Virol* is made from malt extract, marrow fat, yolk of egg and lemon juice. Its composition is stated to be: fat 20, malt extract 60 per cent. *Virvis* is much the same.

Mostelle Grape Juice is the pure fruit of the grape, preserved by pasteurisation before the least fermentation can take place. It contains no alcohol, and its acidity, reckoned as tartaric acid, is 0·50–0·68 per cent. The sugar amounts to about 25 per cent. Diluted, it forms a wholesome non-alcoholic drink. It is very useful for marasmic and ill-nourished infants and seems to possess valuable antiscorbutic properties. It can replace fresh fruit and is moderate in price (1*s.* to 1*s.* 9*d.* per bottle).

The greater the knowledge possessed by the individual of the composition of natural and proprietary foods, and of the various means of modification by simple home methods, the less will he find it necessary to have recourse to the manufactured article, and the better will be the results of his dietetic treatment. Although unnecessary, it must nevertheless be clearly realized that such foods are sometimes of the greatest value. It is equally important to realize that a knowledge of the composition is essential to the proper utilization of any proprietary food.

THE INVALID'S DIETARY

CHAPTER VII

THE INVALID'S DIETARY

BY EDMUND CAUTLEY, M.D., F.R.C.P.

Albumin water.—Take the white of a fresh egg and cut it in numerous directions with scissors. Shake it up in a flask with a pinch of salt and six ounces of pure cold water. Strain through muslin. Assuming that the white of one egg weighs an ounce, the albumin water will contain rather less than two per cent of protein. It is chiefly useful for infants, for vomiting, and as a weak, easily digestible protein food. It can be made with thin barley water and cream or sugar added.

Arrowroot gruel.—Rub up two teaspoonfuls of arrowroot with a little cold water into a smooth paste and pour on it, while stirring, half a pint of boiling water. It may be boiled for three minutes to make it more digestible. If a protein and starchy gruel is desired, make it with plasmon or protene arrowroot. Milk arrowroot is made with boiling milk instead of water. Sugar, nutmeg, or other spices can be used for flavouring, and brandy added, if necessary.

Barley water.—(1) *Thin.*—Put a teaspoonful of prepared or pearl barley, previously washed in clean cold water, into a jug and pour on it half a pint of boiling water and add a pinch of salt. Stand it by the fire for an hour, stirring occasionally, and then strain through fine muslin. Similar thin cereal decoctions can be made from rice, arrowroot or oatmeal.

(2) *Thick.*—Put a heaped tablespoonful of washed, prepared or pearl barley into a clean saucepan and add a quart of water and a pinch of salt. Boil slowly until it has evaporated down to about two-thirds of a quart, and strain. It can be flavoured as desired. The addition of a little lemon peel, while boiling, is best.

Beef juice (1).—Cut up some rump steak or undercut of the sirloin of beef into pieces which will fit into a lemon squeezer.

It is better to use a proper meat press. Broil the meat rapidly before a hot fire or in a frying pan, on both sides, to keep in the juice. Forcibly express the juice, with slow pressure. Season with salt and other condiments if necessary, and give it warm, in a coloured glass or mixed with other foods.

(2) Chop up finely or scrape with a fork or meat scraper, to separate the connective tissue, lean beef and put it in a jar or cup, with a pinch of salt and enough cold water to cover it. Allow it to stand from one to six hours and then squeeze well through coarse muslin. It may be given alone or mixed with other foods, warm or cold, but not hot. It should be warmed by heating the vessel in hot water. The main drawback to this mode of preparation is the liability to decomposition, especially in hot weather.

Beef pulp.—Scrape a piece of raw lean rump steak or sirloin with a fork or meat scraper until as much as possible of the muscular tissue has been obtained, separated from the tendinous parts. Pound it up in a mortar into a pulp and then rub it through a hair sieve. Season with salt and pepper. It may be given to infants in doses of one teaspoonful three times a day, rubbed up with water into a thick cream. Older patients can take it in the form of sandwiches, or rolled up into small rissoles and lightly grilled or fried. It is a very nutritious protein food. Like meat juice it possesses the defect of being liable to decomposition and to transmit the cysticercus of tapeworms.

Beef-tea. (1).— Mince up one pound of lean beef and add to it one pint of pure cold water and ten drops of dilute hydrochloric acid. Let it stand for two or three hours, with occasional stirring, and then simmer for ten to twenty minutes. Do not let it boil. Skim well.

(2) Mince up one pound of lean beef as finely as possible and pound it up in a mortar with a small teaspoonful of salt. Add the meat and its juice to one pint of water at 170° F. in an earthen vessel, and stand it for an hour by the fire, stirring at times. Then strain it through muslin, taking care to squeeze all the juice out of the meat.

Broths.—General method. Broth can be made from any kind of meat, in the proportion of one pound, minced, to the pint of water. It should be stood by the fire for four or five hours and then cooked slowly over the fire, until it has evaporated down to half a pint. Cool, skim off the fat, and strain. It contains about one per cent of protein. Vegetables can be added with advantage. All broths can be thickened by the addition of a farinaceous food, a dried casein preparation, or a meat powder.

Clear soup.—Cut a shin of beef into small pieces and put it in a saucepan with just enough water to cover it. As soon as it boils, skim it, and add a bundle of sweet herbs, turnip, carrot, celery, salt and pepper. Add more water and let the whole boil for three hours. Strain and stand it on one side until the next day. Skim off all fat, add browning to taste, and heat it again. Beat up two eggs to a froth and put them into the soup with a whisk. Boil gently for ten minutes and strain through a cloth.

Caudle.—Beat up an egg to a froth, add a glass of sherry and half a pint of gruel. Flavour with lemon peel, nutmeg and sugar.

Cornflour mould.—Put one pint of milk, or equal parts of milk and water, into a clean milk saucepan or enamelled pan, and bring it to a boil; add a pinch of salt. Mix a quarter of an ounce of cornflour into a thin paste with a little cold water and stir it into the milk, when nearly boiling. Boil gently for ten to twenty minutes. Other cereal moulds can be made in a similar manner.

Egg-nog.—Scald some new milk by putting it in a jug into a saucepan of boiling water, but do not let it boil. Beat up a fresh egg with a fork in a tumbler with some white sugar. Add a dessertspoonful of brandy and fill up the tumbler with the scalded milk when cold.

Egg and brandy.—Rub up the yolks of two eggs with one tablespoonful of white sugar, four of brandy and eight of cinnamon water. Dose: one teaspoonful to one tablespoonful every two hours.

Frankland's artificial human milk.—Allow one-third of a pint of cows' milk to stand for twelve hours; remove the cream and mix it with two-thirds of a pint of fresh milk. Add to the milk, from which the cream has been removed, a small piece of rennet or a little liquid rennet, and keep it in a warm place until fully curdled, usually in about ten to fifteen minutes. Break up the curd thoroughly and separate the whey, which should then be rapidly brought to a boil to destroy the rennet ferment. Strain through muslin and add 110 grains of milk sugar. Mix this with the original two-thirds of the milk to which the cream was added.

Gelatin.—Soak a piece of plate gelatin, two inches square, in cold water for three hours and then dissolve it, with stirring, in half a pint of boiling water. It forms a jelly on cooling. One or two teaspoonfuls may be added to the milk for a baby's feed to prevent the formation of large curds.

Imperial drink.—Pour a pint of boiling water on to a large teaspoonful of cream of tartar, a little sugar and some lemon peel. Strain when cold. It is cooling and diuretic.

Junket.—Heat a pint of milk to a temperature at which it can just be comfortably sipped and add, with gentle stirring, one of the preparations of rennet, two teaspoonfuls of wine of pepsin or an essence of pepsin. Let it stand until firmly curdled and serve with sugar, nutmeg, cream, or stewed fruits. It can be enriched by the addition of one or two eggs before curdling.

Lemonade.—(1) Pare the rind off a lemon thinly and cut the lemon in slices. Put the whole in a jug with one ounce of white sugar and pour on a pint of boiling water. Cover the jug closely and strain when cold.

(2) Rub two or three lumps of sugar on the rind of the lemon, cut it in half and squeeze out the juice. Add one-half to three-fourths of a pint of cold, iced or aerated water.

(3) Effervescing.—Make the lemonade with cold water as in the second method and add half a teaspoonful of bicarbonate of soda or potash.

Linseed tea.—Add to a pint of water two tablespoonfuls of linseed, a quarter of an ounce of bruised liquorice root or a piece of liquorice as big as a filbert, and sugar candy to taste. Boil for half an hour and strain.

Oatmeal gruel.—Made like arrowroot gruel; q.v.

Oatmeal porridge.—Add half a teaspoonful of salt to a pint of boiling water in a saucepan and sprinkle in three or four ounces of oatmeal, until sufficiently thick, keeping it constantly stirred with a porridge stick. Boil gently for fifteen minutes; add a little more water and boil for another five minutes. Serve with salt, milk, cream, sugar, golden syrup, maple syrup, etc.

Oatmeal water.—Made like barley water, q.v.; or put a large tablespoonful of oatmeal porridge into a quart of cold water and heat, with constant stirring, to boiling point; strain.

Peptonized meat.—Add four ounces of minced meat to half a pint of water and gradually bring to a boil. Then add half a pint of cold water, so as to reduce the temperature to about 140° F., and add thirty grains of zymine and twenty of bicarbonate of soda. The latter need not be added if Fairchild's zymine powders are used. Keep warm for three hours and the meat will be peptonized.

Raw meat emulsion.—Take two ounces of beef pulp, half an ounce of blanched sweet almonds, half a bitter almond, and half an ounce of white sugar. Pound them up in a mortar and add enough water to make an emulsion.

Rice pudding.—Cover the bottom of a dish with clean rice, nearly fill with milk, and add sugar; put it in a slow oven for three hours and in the hottest part of the oven for fifteen minutes.

Rice and egg pudding.—Take three ounces of rice and swell it gently in one pint of new milk. Let it cool, and stir well into it one ounce of fresh butter, two ounces of powdered sugar, the yolks of three eggs and some grated lemon peel. Pour into a well-buttered dish and put on the top the whites of the three eggs, beaten up with three tablespoonfuls of powdered sugar. Bake for twenty minutes, until lightly browned.

Rice water.—Made like barley water, q.v.

Toast water.—Pour a pint of boiling water on to two or three slices of well toasted bread. Let it stand until cool; strain.

Treacle posset.—Add a pint of boiling milk to two or three tablespoonfuls of treacle or golden syrup. Boil well and strain.

Whey.—Curdle milk as in the making of junket and allow the curd to stand until by contraction it squeezes out the whey. Or break up the curd with a fork and strain. Or, in addition, squeeze the curd finally through muslin or a coarse cheese cloth.

Wine whey.—Add two ounces of best cooking sherry to half a pint of boiling milk, without stirring, and continue the heating until the milk again boils up. Remove from the fire, stand it for three minutes and strain.

ALCOHOL IN HEALTH AND DISEASE

CHAPTER VIII

ALCOHOL IN HEALTH AND DISEASE

BY HARRY CAMPBELL, M.D., F.R.C.P.

THE term "alcohol" in popular language refers to the ethylic variety of the di-carbon series (C_2H_5OH). Alcoholic drinks, however, contain other substances besides alcohol, and the effects of these latter upon the human organism have to be taken into account as well as those of the alcohol itself.

Ethyl alcohol is obtained by the fermentation of grape sugar, whereof a single molecule yields two molecules of alcohol and carbonic acid respectively ($C_6H_{12}O_6 = 2C_2H_5OH + 2CO_2$). During the process most of the carbonic acid escapes as gas, only a small part remaining in solution, but if the alcoholic solution is bottled up before fermentation is complete, a large amount of the carbonic acid may be held in solution, escaping with effervescence when the pressure is removed.

The grape sugar from which alcohol is derived is obtained from a variety of vegetable substances. The chief are grain (especially barley) and the grape, but numerous other substances are employed in its manufacture, including potatoes and even sawdust, the latter being converted into fermentable sugar by means of acids.

Antiquity of alcohol.—The discovery of alcohol probably does not date further back than the time when man first began to cultivate the vegetable kingdom for food. Certain it is that all extant pre-agricultural peoples were ignorant of it until they came into touch with agricultural man; while, on the other hand, practically all the early agriculturists—the red-skins of America, the negroes of the vast continent of Africa, the inhabitants of the numerous islands scattered throughout the Pacific—have long brewed alcohol, a fact not, we think, generally known.

The absence of alcohol among the pre-agriculturists cannot be explained by their lack of substances especially suitable for fermentation, such as barley, maize, and the grape, for apart from the fact that the uncultivated vegetable kingdom yields many fermentable materials, almost all the pre-agriculturists are abundantly supplied with honey, the source of that once so popular British drink known as mead. Curious though it may seem, it is therefore probable that their non-use of alcohol is due simply to the fact of their having no vessels suitable for brewing it. Such vessels as they have consist of shells, gourds, bottles made from skins or closely plaited rushes, and the like—all unfitted for the retention of large quantities of fermenting liquor. It was not until the introduction of agriculture that man began to make pottery, while the manufacture of glass vessels and wooden barrels is of much later date.

Assuming, then, that man began to brew alcohol about the same time that he began to cultivate the soil, we may estimate the antiquity of alcohol by reference to that of agriculture. Now though we have no means of gauging with precision the date at which agriculture arose, we shall probably not be far wrong in placing it some thirty thousand years back, i.e. about fifteen thousand years before the rise of the Egyptian civilization; and if we suppose that man's evolution from his anthropoid precursor occupied a million years, the discovery of alcohol must, in the light of those unchronicled ages, be regarded as of comparatively recent date. In any case it is clear that man had come well within reach of the highest rung of his long evolution ladder before he learnt to brew intoxicating liquors.

But while possibly acquainted with alcohol for so long a period as three thousand decades, it was not until he had attained a civilized state, say fifteen thousand years ago, that chronic drunkenness was possible for him. For early agricultural man, even though knowing how to make alcohol, had no adequate means of storing and distributing it, and not being able to get a continuous supply, he consequently was unable to indulge in systematic drinking. Such drunkenness as he did, or does (for it is well to remember that the early agricultural stage is still represented among the races of mankind) indulge in, apart from the influence of the white man, was, and is, essentially spasmodic, and connected for the most part with special festivals or ceremonials, for each of which the alcohol must be specially brewed.

It is necessary to insist upon this point because alcohol could not have exerted any marked racial effect on man until he had the opportunity of becoming not merely occasionally, but continuously, drunk.

The racial effects of inebriety.—Before discussing the racial effects of inebriety, that is to say, before asking how far drunkenness in the parents influences the offspring—a subject of great importance, and one regarding which much misapprehension prevails—it will be necessary to refer to certain facts of heredity. It has long been known that inebriety runs in families, and that the children of drunkards are often degenerate, displaying a tendency to drunkenness, epilepsy, and other neuroses, even if they are not actually imbecile. Medical men, noting these facts, have too readily attributed this degeneracy to the parental drunkenness, overlooking the possibility that the latter might itself be the result of inborn defect in nervous organization.

We now know, however, that acquired characters, i.e. characters impressed upon the soma by environmental influences, are not inheritable. No matter how profoundly the parental tissues are injured by drink, the effects cannot be transmitted to the offspring. So much might be postulated *à priori*. How, for instance, is it possible for a nervous system which has undergone alcoholic degeneration so to influence the reproductive elements that these latter shall give rise to a nervous system presenting the same degenerative tendencies ? No doubt chronic drunkenness in the pregnant woman may produce specific effects on the tissues of her child, but in such a case we have to do, not with the hereditary effects of parental drunkenness, but with an alcoholized fœtus, and to reason otherwise is to confuse the issues.

This position may be made clear by reference to the mechanism of heredity. That heredity depends upon the continuity of the germ plasm may be regarded as certain ; we may even go further than this and assume with Beard—for convenience of demonstration, at all events—that there is an actual continuity of germ cells. According to this observer the zygote, or cell formed by the union of germ and sperm, divides and subdivides until a colony of several hundreds of cells is produced. This cell colony, however, is not the embryo. The latter is formed from one special cell belonging to the colony: the cell signalled out for this distinction itself multiplies by division, like the zygote, and in this way forms the soma of the new being, while the remaining cells of the colony are enclosed by the soma of which they constitute the reproductive cells. It will be observed that these cells are thus sister-cells of the primitive cell whence the new being is derived, a fact which explains how it is that they share the same hereditary tendencies.

This view, which we have little doubt is essentially correct, renders the mechanism of the hereditary process—so far at least as its broader features are concerned—perfectly intelligible. From it we see that, inasmuch as the soma merely houses and nourishes the reproductive cells, impressions made upon that soma cannot possibly be inherited.

It may, however, be argued that the constant soakage of the reproductive elements in an alcoholized plasma necessarily injures them, and thus interferes with the normal development of the new being arising from them. It must suffice here to point out that all the evidence bearing upon the matter tends to show that germ and sperm are phenomenally resistant to outside influences, nocuous or otherwise: their chromosomes, i.e. those nuclear elements which are the bearers of hereditary tendencies, are singularly stable in constitution. And, indeed, this strong resisting power of sperm and germ might have been postulated *à priori*. No one can pass through life with a constantly normal plasma; every passing illness tends to affect that fluid injuriously, and were the reproductive cells readily injured by nocuous plasma, the effects accumulating from generation to generation would soon result in racial extinction. The same result would follow were injurious somatic impresses (acquired characters) inherited. From birth onwards the tissues are constantly undergoing disorganization, microscopic and macroscopic, in consequence of the operation upon them of nocuous agencies, and in this way they may at quite an early period of life be abundantly scarred; from which it is manifest that were these effects inherited they would in a few generations accumulate to a degree incompatible with life. Their non-inheritability enables each individual to start life with a more or less clean chart, and is thus a primal essential to biological evolution. To Dr. Archdall Reid belongs the credit of enunciating this important truth.

These considerations must influence our views not merely of the degeneration produced by unmistakable drunkenness, but also of the evil effects of lesser degrees of intemperance, and it must not be forgotten that a large number of people who are accounted strictly temperate consume more alcohol than is good for them. Such reflections make it evident that were the acquired effects of alcohol inherited, all civilized communities would long since have become extinct.

While therefore chronic alcoholism produces profound **individual** deterioration, it does not cause **racial deterioration.** It does, however, produce a racial effect, but this, far from being an injurious one as some, and among them Dr. Ford Robertson, assume, is, on the contrary, beneficial, for drunkenness, tending as it does to fasten upon congenital degenerates, hastens their elimination; and this from a racial point of view is an advantage. In short, those lacking in moral grit or unmistakably degenerate, tend by means of alcohol to be eliminated more speedily than they would otherwise be.

Not only does alcohol, with cruel kindness, perform a service in purging the race of its undesirables, but it produces, in the language of Dr. Archdall Reid, "an evolution against itself." By the elimination of those who are least capable of resisting alcohol the race is becoming increasingly resistant to alcohol. This resistance is of twofold nature: (*a*) physical, and (*b*) psychical. (*a*) People differ in the resistance which their tissues, notably those of the nervous system, offer to alcohol. In some, for example, the brain is very easily affected by it, and, as we shall see, in many cases of insanity which are attributed to alcohol there has been no alcoholic excess as judged by the ordinary standard. Members of this class tend to be weeded out by means of alcohol. (*b*) Those who are highly susceptible to what we may call the charm of alcohol run much greater risk of inebriety than those for whom it has no attraction, and by their elimination through successive generations the race tends to become more and more soberly inclined.

Since this "evolution against alcohol" can only take place in communities possessing the means of chronic intemperance—i.e. having a constant supply of alcohol—it could not have begun until the advent of civilization. It is further obvious that it has been longest in operation among those communities which possess the most ancient civilizations. These we must therefore expect to be the most temperate by disposition, and such actually appears to be the case. Civilization in all probability began in the north of Africa, spreading eastwards to Babylonia and Assyria, and northwards into Southern Europe, and it is a remarkable fact that the Jews and the inhabitants of Southern Europe display a high degree of sobriety. On the other hand, among the northern Europeans, whose civilization is of more recent date, the evolution against alcohol has made less way, and as a consequence we find these much more addicted to drunkenness; while primitive peoples, who have had no opportunities for systematic drunkenness, even though among many of them there has been desultory drinking for thousands of years, show no resisting power whatever against the ravages of drink, but succumb with terrible facility when a constant supply of alcohol is put within their reach.

Inasmuch as it may now be looked upon as impossible to banish alcohol from the world, or to ensure national temperance either by legislation or by private effort—though doubtless much may be done in these directions by judicious action—Dr. Reid contends that the only way to fight the drink fiend with any hope of lasting success is by the continual elimination of those who, alcoholically considered, are unfit, so as to allow the evolution against alcohol steadily to proceed. While using every legitimate means to protect this unhappy class from the misery and degradation which drunkenness entails, he would seek to make them realize their responsibility to the race, and abstain from propagating their kind. Doubtless this is a counsel of perfection, but it is well that the medical profession should clearly understand the racial aspect of the drink question:

The fact that the degeneration caused by alcohol is not inherited;

The fact that civilized peoples tend to become racially resistant to alcohol;

The impossibility of banishing alcohol from the world, or of effectually protecting the born drinker from the poison which is his doom;

And, above all,

The responsibility placed upon the medical man of preventing, as far as in him lies, the propagation of congenital inebriates.

The physiology of chemical stimulation.—We may now touch upon a different aspect of the drink problem. How are we to account for the deep-rooted and widespread love of alcohol shown by mankind? One fact stands out prominently in this connexion, namely, that man all the world over displays an instinctive liking for stimulating substances generally. This is shown by such practices as betel chewing in the East and pitcheree chewing among the Australians.

Can we bring this love of things stimulating into line with any physiological principle? We would suggest that the blood normally contains materials having an action on the nervous system not unlike that of alcohol and kindred substances. We now know that this remarkable fluid—the most subtly complex in nature—contains, besides nutrient materials and useless waste-products, substances (hormones) whose special purpose it is to stimulate function. Our knowledge of their action on the nervous system is at present limited, but it may well be that they play a much larger part in this direction than has hitherto been suspected. It is probable that some hormones exercise a sedative, others a tonic, and others, again, a stimulating, or even slightly intoxicating, effect upon the brain, much in the same way as do morphia, strychnine, and alcohol, and that the sense of exuberant well-being sometimes experienced is in large measure due to the combined action of such substances, just as the opposite condition of lassitude and depression may be due to the accumulation in the blood of others having a contrary effect. We may, in short, think of the brain as an instrument played upon by a number of chemical agencies which may be roughly grouped into stimulants and depressants, i.e. those which cause a sense of well-being and those which cause malaise, and we may conceive of this mind-instrument as yielding harmonies joyous or sad according as the one or the other group of agencies strikes the tune.

Now, given that the blood normally contains mildly sedative, tonic, and stimulating substances, and that the sense of exuberant well-being and joyous emotion is largely due to them, is it any wonder that man, having discovered an essence capable of producing similar effects, should, all ignorant of the danger he runs, fly to it with the blind impetuosity of the moth rushing into the destroying flame ?

We must not be misunderstood here. We are very far from arguing that, because the tissue fluids normally contain substances which engender feelings of health and happiness, man therefore stands in need of artificial stimulants. The normal nerve stimulants are of such nature and present in such proportions, as to promote rather than to injure health, whereas alcoholic drinks, even when taken in moderation, are apt to be harmful, and are but too often imbibed in quantities which are unmistakably poisonous. It is even possible that an excess of the normal blood stimulants would be injurious. We have merely sought to offer a physiological explanation of the all but universal liking of men for artificial stimuli of one sort or another.

Here we are tempted to raise the question whether the impulsive craving for alcohol sometimes observed in the congenital neurotic may not possibly be due to the deficiency in the blood of its normal proportion of stimulants. That dypsomania showing itself in paroxysmal craving for alcohol owns such a pathology seems not unlikely. Be this as it may, we feel assured that the nervous diathesis is essentially dependent upon the composition of the blood—that an individual is nervously disposed because his blood makes him so.

Is alcohol a food ?—The question whether alcohol is a food has been much debated. Like sugar, to which it is chemically allied, it is capable of furnishing energy by its oxidation ; the alcohol in a pint of Guiness' stout, for instance, is equivalent to 230 calories. Now there can be no doubt that alcohol undergoes oxidation in the tissues: taken in moderate quantities the whole of it suffers oxidation, though taken in larger, some, no doubt, escapes unoxidized with the breath and the urine. It is therefore evident that ingested alcohol furnishes some energy to the organism. Whether this energy is manifested entirely as heat, or whether some of it may, like that evoked by sugar, be converted by the muscles into "work," we do not know. But in deciding the question whether alcohol is to be regarded as a food, it has to be remembered that the actual amount of energy yielded by permissible doses of alcohol is very small—no more than can be furnished by a quite insignificant amount of starch, sugar, or fat; further, that alcohol promotes the dissipation of heat from the body, a loss which must be set against the heat gain resulting from its oxidation; and, finally, that there is evidence to show that even if alcohol is capable of furnishing a spurt of energy for muscular work, its administration far from enhancing the capacity of the muscles for sustained activity tends, in point of fact, to lower it.

On the other hand, there can be no question that the consumption of alcohol promotes fat formation, and diminishes the amount of food needful to sustain the body weight. Thus it will often be found that when a person accustomed to alcohol suddenly leaves it off, he eats more. Naturally, malt liquors are fattening owing to the large amount of saccharides they contain, but spirits may sometimes be observed to produce the same effect. We have seen an abstainer rapidly increase in weight after adding to his dietary a daily allowance of two glasses of whisky. It is probable, however, that when alcohol is taken in physiological quantities its influence in augmenting body weight or in curtailing the needful amount of starch, sugar, fat, or protein, is very small.

To sum up: the consumption of alcohol leads to an increase in the production of heat, which, however, is met by a corresponding, or even greater, heat loss; it may possibly furnish energy for muscular contraction, but, on the other hand, it diminishes the capacity for sustained muscular work; it promotes the laying-on of fat, and diminishes the amount of food needful to sustain the body weight, but when taken in physiological quantities its effect in these two directions is, under normal conditions at least, exceedingly small.

There is yet one other consideration. It has to be remembered that alcohol differs from all other foods in the rapidity with which it is absorbed, in that it undergoes immediate absorption without requiring any preliminary digestion.

Influence on metabolism.—Alcohol has a strong affinity for oxygen, and consequently its ingestion checks the process of oxidation within the body, either of the food-stuffs before they have been built up into protoplasm, or of the protoplasm itself. It is probably largely on this account that it promotes the laying-on of fat and when taken in excess leads to widespread fatty degeneration. It is worthy of note that in this respect alcohol acts like some other vegetable poisons, such, for instance, as certain of the diphtheritic toxins, which also, curiously, further resemble alcohol in their tendency to set up neuritis. The fatty degeneration of chronic alcoholism is perhaps most characteristically seen in the liver and the heart. The fatty heart of chronic alcoholism is, according to Dr. Wynn Wescott, the well-known coroner, the most common cause of sudden death.

Action on the digestive system.—Experiments show that alcohol retards digestion *in vitro*, but we cannot conclude from this that a moderate quantity of it has a similar effect in the living stomach: in this case we have to take into account not only its influence on ferment action, but also on secretion and on the movements of the stomach. We can, indeed, only judge of its action on digestion by experience, and experience shows that, in many cases at least, a sound alcoholic beverage taken in moderation does not appreciably injure digestion, while in the feeble and delicate it may promote the process, both by its psychic effect and by its more direct action on the gastric mucous membrane.

But whatever view be held as to the effect on digestion of a moderate quantity of a sound alcoholic drink, it is certain that when taken immoderately, or in impure forms, alcohol upsets digestion and leads in course of time to degenerative changes in the whole of the alimentary tract. Most conspicuous among these is catarrh of the mucous lining. This leads to an excessive outpouring of mucus and to a gradual atrophy of the epithelium, with concomitant fibrosis.

The mucus being thus in excess and the digestive juices at the same time deficient, not only is normal digestion interfered with, but the development of saprophytic organisms is favoured: the alimentary tract in consequence becomes a veritable laboratory for the manufacture of poisons which, rushing the defences provided by the alimentary mucous membrane and the liver, gain entrance into the blood, and thus set up a condition of "indigestion toxæmia," as we may term it. Dr. Ford Robertson contends that it is to this secondary toxæmia, rather than to the alcohol itself, that the degenerative changes of chronic alcoholism are mainly due.

That the absorption of poisons from the alimentary tract may cause widespread tissue-degradation there can be no doubt. Now the more perfect the digestion in stomach and bowel, but especially in the latter, the less is the tendency to indigestion toxæmia and to the consequent degeneration of the tissues at large; and it is therefore not surprising that centenarians generally give a history of sound digestion. Metchnicoff has suggested that the absorption of poisons from the large bowel plays a prominent part in bringing about senility. Whether or not this is the case there can be no doubt that the living organism does not simply wear out, but that it becomes senile—just as it becomes adolescent—essentially by the operation of definite vital mechanisms, though what, precisely, those mechanisms are we do not yet know. Probably the absorption of poisons from the alimentary tract—though rather, we would suggest, from the small than the large bowel—is one, but only one, among many such mechanisms. The view that the possession of a colon is an important factor in the induction of senility has, in our opinion, obtained wider circulation and credence than it deserves, but be this as it may, it is certain that sound digestion promotes sound nutrition and therefore tends to delay the onset of senile decay, while it is equally certain that the abuse of alcohol, by disturbing digestion and thus inducing toxæmia, favours its premature occurrence.

The well-known "morning sickness" of the drunkard is due to gastritis. His gastric indigestion results not only from disease of the gastric mucous membrane, but also from atony of the muscular coat of the stomach, in consequence of which the food tends to linger in it unduly. A similar atony may affect the bowel.

Degenerations from chronic alcoholism.—The most characteristic degenerative changes met with in chronic alcoholism are fatty change and atrophy of the parenchyma, with a corresponding increment of connective tissue. These changes, as might be expected, are generally most pronounced in the alimentary tract and in the liver, but no tissue is exempt from them. Their distribution varies in different subjects: sometimes the liver is most affected, sometimes the nervous system, sometimes, again, it is the cardio-vascular system—a fact which lends support to the view that the changes in question are produced, not by the direct action of the alcohol only, but by the indigestion toxæmia which it sets up, the exact nature of this toxæmia differing, we may suppose, in different subjects.

The liver in the chronic alcoholic tends in the first instance to become congested. Later, fibrosis occurs, together with fatty degeneration of the liver cells, though it is doubtful whether fibrosis culminating in "hob-nailed liver" is so characteristically associated with deep potations as has been thought. Not only is its occurrence among hard drinkers infrequent, but it is met with in those who have led perfectly healthy lives.

The heart of the alcoholic tends to undergo fatty degeneration and frequently exhibits fibroid change. It has also been definitely shown that excessive drinking favours arterial sclerosis.

While chronic alcoholism predisposes the kidneys, in common with all other organs and tissues, to inflammatory affections, it cannot be regarded as more than a subsidiary factor in the causation of granular kidney.

The nervous system is peculiarly susceptible to the action of alcohol, and tends in the inebriate to degenerate throughout its entire extent. The changes may be acute, as in peripheral neuritis, or, as more frequently happens, chronic. In the latter case the neurons atrophy, their place being taken by fibrous tissue. One of the first changes observable in the body of the neurons is a diminution in the number of their dendrites, and this interferes not only with the more organic aspects of neural function, such as muscular co-ordination and vaso-motor action, but with the proper association of ideas on which memory, judgment, and all the higher operations of mind depend. These dendritic changes are accompanied and followed by changes in the body of the neuron: the nucleus travels towards the periphery, the protoplasm ceases to take up stains in the normal way, and finally, the whole cell shrinks, becoming the mere ghost of its former self. In addition to these parenchymatous changes an abundant fibrosis occurs throughout the brain and spinal cord, while an inflammatory thickening of the meninges —especially those of the brain—is often met with.

Action in weakening the defences of the body.—It has long been observed that intemperance renders the tissues vulnerable to disease, that in the sot wounds are apt to fester, that he is not only more liable than his temperate brother to contract pneumonia, but to die if he does contract it, and that gonorrhœa is aggravated by even moderate quantities of alcohol.

Such facts as these we now explain by saying that alcohol, when taken in excess, weakens the natural defences of the body against certain bacteria. This is now known to be true of a large number of microbic affections, foremost among which is tuberculosis, and recent researches further show that cancer—also possibly parasitic in nature—is more common among the drunken than the sober; again, it has been experimentally demonstrated that alcohol weakens the defences against the microbes of hydrophobia, tetanus, and anthrax. So greatly, indeed, do even small doses interfere with the process of immunisation against hydrophobia that it has been advised to forbid its use by patients while undergoing immunising treatment against this disease and for some time after.

This disarmament of the body by alcohol must not be forgotten in our treatment of the specific fevers, though doubtless alcohol is much more rapidly burnt off during fever than otherwise. Not only does the drunkard offer a subnormal resistance to the microbic battalions, but he is placed at a great disadvantage by reason of the degenerated condition of his heart: even a sound heart is sorely taxed in battling through a severe fever; one which enters upon the struggle in a state of advanced fatty degeneration has small chance of emerging successful.

Action on the cardio-vascular system.—(*a*) The arteries. On entering the stomach alcohol causes the gastric blood-vessels to dilate. Absorption is rapid, the maximum amount being present in the blood about fifteen minutes after ingestion. Once in the blood alcohol produces a dilatation of the cutaneous arterioles, thus diverting a large quantity of blood to the surface of the body and giving rise to a feeling of warmth. This is especially noticeable in the hands and feet, should these have been cold previously. In some alcohol is liable to cause flushing of the face, and, if freely indulged in, it may in such subjects lead to a permanent dilatation of the vessels of the cheeks and nose, at the same time predisposing to acne rosacea. The latter affection, however, it should in justice be observed, is not infrequently met with in the strictly temperate, just as, contrariwise, inveterate drinkers may retain pale faces.

By diverting a large quantity of blood to the surface of the body alcohol tends, while producing a temporary sensation of warmth, to reduce the body temperature. A lowering of several degrees may in this way be effected; the lowest body temperatures met with in the living subject have, in fact, occurred in the drunken. It is largely for this effect that alcohol is employed in febrile states. It may sometimes be given with advantage as a preliminary to the cold bath when the superficial vessels are strongly contracted, for it relaxes these and thus promotes the cooling of the blood by the bath.

Seeing that alcohol dilates the cutaneous vessels, those who are exposed to great cold should abstain from it. This fact has long been recognized by the inhabitants of cold regions and by arctic explorers; for them alcohol spells death. Nansen would not allow a single drop of alcohol in his expeditions, not even for medicinal purposes. It is probable that most of the cases of death from cold recorded in the newspapers would be more correctly described as deaths from drink: a man falls down drunk on a cold night and sleeps his drunken sleep for the last time; under the influence of the alcohol his temperature is lowered beyond the point compatible with life.

(*b*) The heart. Large doses of alcohol paralyse the heart. Smaller doses may cause an increased frequency of the beat, in part reflexly, by stimulating the gastric mucous membrane, and in part, perhaps, by acting directly upon the nerves and muscle of the heart itself. Alcohol can hardly, however, be said to be a genuine cardiac stimulant under normal conditions, though in fainting and in debilitated states of the body it may act as such.

Action on the nervous system.—The nervous system consists of a sort of hierarchy of centres, of which the highest subserve the highest functions of mind—reason and judgment—and the lowest (in immediate connexion with the non-nervous tissues) the more purely organic functions, such as muscular contraction and secretion.

In this hierarchy each level is in some degree dominated by that next above it, all levels below the highest being thus in some measure under the control of the highest. Now, speaking generally, it is found that the susceptibility of the various levels to the action of alcohol is in direct proportion to their hierarchal rank, the highest (psychic) centres being the most readily, the lowest (organic) centres, such as those presiding over the functions of the heart and the voluntary muscles, the least readily, affected. Thus we find that alcohol very early affects the mental activities. When the supreme psychic centres are in unrestrained activity, the emotional nature is under fullest control, and least apt to dominate thought and action; then it is that mental vision is clearest, judgment keenest. Alcohol, by weakening the sway of the highest centres and allowing the emotional nature to assert itself, blurs the judgment. When a man indulges in it his ideas may flow more readily, his tongue be loosened, and there may be a show of brilliancy, but it is brilliancy of the spurious and superficial kind, appraised at its true value by severely sober companions and often by his own cooler judgment the following day. The successful man of business does not act on judgments formed under the influence of the convivial glass, but is careful to check them subsequently by the cold, clear light of undrugged reason.

The alcoholized individual is apt to form an exaggerated estimate of his own powers, and on this account we must not too readily accept the opinion of people as to the effect of alcohol on their working capacity. They may be under the impression that alcohol increases their capacity for muscle and brain work when all the time it is actually having an opposite effect.

It is largely because alcohol relaxes the control over the emotions that its so-called " stimulant " action is due. If we define a stimulant as that which unlocks pent-up energy and renders it available for use, then alcohol may be said to act as a stimulant when it arouses the combative instinct and incites to acts of violence ; but it should be noticed that in this case the liberated energy is misdirected—not turned to useful account—and being, moreover, followed by a period of reaction, we have scarcely here to do with a genuine instance of stimulation.

It is now, indeed, generally admitted that the action of alcohol is sedative and narcotic rather than stimulant. Its power to soothe is well shown in the case of the jaded and irritable brain-worker and in the muttering delirium of typhoid fever. Alcohol may, however, act as a genuine cardiac stimulant in fainting, while its effect is certainly stimulant in many cases of general debility with feeble digestion, in which it operates essentially by improving digestion.

We have seen that the highest psychic centres exercise control over the lower. There are occasions when it is good to relax somewhat this inhibitory influence. Some people, be it from natural temperament or as the result of deliberate self-repression, suffer from an excess of psychic inhibition, always reining themselves in, never " letting themselves go," as we say. An occasional relaxation of control may in such cases be of benefit. It may be brought about by congenial social intercourse, by going away for a holiday, when many a man casts off his habitual reserve and surprises his friends by his unwonted geniality, or again by recourse to alcohol, under the influence of which the most reserved natures will sometimes expand astonishingly. We are naturally chary in recommending alcohol for the purpose of diminishing psychic inhibition, but it cannot be denied that a little stimulant may sometimes do real good in this way. Take such a case as the following: A sensitive, retiring, self-conscious, and somewhat taciturn man loses, after a couple of glasses of champagne, all his self-consciousness and becomes the life and soul of his party. We cannot, of course, advise a man of this type habitually to indulge in alcohol in order to break down his excessive reserve, but it must be admitted that the condition of mind induced by it in him, and which finds expression in joyousness and the abundant flow of pleasing thoughts, is yet, though certainly not that in which the intellect is most discriminating, in many respects superior to his habitual mental state. Such a case is interesting to us because it raises the question whether those who are naturally vivacious and chatty may not owe their mental temperament to the habitual presence in the blood of substances so far similar to alcohol as to be productive of similar results.

The aphorism *in vino veritas* is only partly correct. True, alcohol by weakening restraint allows many potential characteristics to reveal themselves, but if the real man is to be estimated by all his psychic potentialities, by all the emotions, thoughts, and acts of which he is capable under drug influence, then assuredly none of us would see salvation. Rather should we take the measure of the man when his will has undisputed sway and when the baser part of him slumbers in the depths of his unconscious being.

V. Kraepelin has submitted the influence of alcohol on mental operations to a variety of ingenious tests. He finds that even a moderate quantity interferes with mentation (e.g. with the rate of arithmetical calculation), that it causes a lengthening of the reaction time (i.e. the period intervening between the occurrence of a stimulus, such as the disclosure of an object to vision or the sounding a bell, and the voluntary response to that stimulus), and that it renders less precise movements requiring delicate manipulation, such as those employed in playing musical instruments, billiards, golf, or in shooting. Thus it has been shown that compositors can work more rapidly without alcohol than with it, although when under its influence they may themselves be firmly convinced that they are getting through more work than they could without it.

This is the place to consider the **part played by alcohol in the causation of insanity.** In asylum reports, inebriety easily heads the list among the causes stated, and most authorities regard it as responsible for at least 20 per cent of all cases of insanity ; some go so far as to attribute to it, directly or indirectly, 50 per cent of them. There can be no doubt that alcoholism, on account of the poverty which it entails and the syphilis which follows in its wake, is indirectly responsible for a large amount of insanity, but recent researches tend to show that its rôle as the direct cause has been over-estimated. Mott has noticed that while on the one hand the insane but rarely exhibit the tissue degeneration of the drunkard, on the other their minds are often peculiarly susceptible to the influence of alcohol, many pillars of society imbibing with apparent impunity an amount which would make the susceptible raving lunatics. It would appear, therefore, that those whose insanity is attributable to alcohol are by nature predisposed to insanity, and that they are so organized that a very small quantity of the drug suffices to upset their mental balance : many of this class would no doubt have become insane, even had they never tasted a drop of intoxicating liquor. That chronic alcoholism of a pronounced kind is not *per se* greatly productive of insanity is borne out, we think, by daily experience. Among the large number of inveterate inebriates one meets in the ordinary social way, how many, we would ask, become insane ? We ourselves cannot recall a single instance. The chronic alcoholic certainly degenerates mentally : his memory fails, he becomes suspicious and untruthful (largely on account of his defective memory and his inability to visualize his mental images clearly) ; he loses self-respect and will-power, or at least will-power directed to virtuous purpose, for he often displays abundant strength of will in gaining his own drunken ends—but he only exceptionally becomes insane.

Persons afflicted with so-called alcoholic insanity can, then, only in exceptional cases be described as genuine inebriates : it is rare for them to indulge in large quantities of alcohol. On the other hand, there is a class of congenital inebriates who readily take to alcohol but who do not become insane. Indeed, so high an authority as Dr. Branthwaite, His Majesty's Inspector under the Inebriates' Act, maintains that the sot becomes a sot essentially because he possesses a defective nervous organization, either congenitally or as the result of shock or illness, and that the normally constituted person rarely takes to drink. Alcohol, he contends, is, in fact, an effective test of soundness of nervous organization, and the circumstance that so many of our hardest workers and profoundest thinkers partake of it liberally without becoming drunkards is *ipso facto* evidence of the stability of their nervous systems. We accept Dr. Branthwaite's dictum if stated thus: a person who *under average exposure to temptation* becomes a drunkard is probably defective as regards his nervous system. This qualification seems needful, for assuredly the large percentage of drunkenness among publicans and potmen is due to excess of temptation rather than of proclivity.

Nor even among those who become drunkards under an average exposure to temptation must we overlook the influence of the personal liking for alcohol, which liking has no necessary relation to unsoundness of nervous constitution. For though an inordinate love of alcohol is probably strongest among nervous degenerates, persons of sound nervous constitution may have it, and we can conceive of its leading such occasionally into intemperance, just as, on the other hand, pronounced degenerates often remain sober under ordinary temptation simply because alcohol has no special attraction for them.

Action on the muscular system.—We have seen that alcohol through its action on the nervous system interferes with the accurate performance of delicate movements. Here we have to consider its influence on the muscles themselves—on the capacity of the muscle-machine to perform work. Does the taking of alcohol increase that capacity? Can a man, e.g. do more brickmaking or platelaying, or can a soldier march better, with alcohol than without it? This question can be answered definitely. It has been proved incontestably that while the taking of alcohol may doubtless, by its action on the nervous system, lead to a temporary spurt in muscular activity, it reduces the total daily output of work, and the fact is so well recognized by employers of labour that when it is urgently necessary to get the maximum of work out of their men, they do their best to keep alcohol from them. When, e.g. the gauge of the Great Western Railway had to be altered within the short time of 24 hours the contractors were careful to take this precaution. The testimony of experienced generals, again, is unanimous against allowing alcohol to the soldier on campaign, and their opinion is confirmed by that of Sir Frederick Treves: "As a work producer alcohol is exceedingly extravagant, and like all other extravagant measures, leads to physical bankruptcy. It is also curious that troops cannot work or march on alcohol. I was, as you know, with the relief column that moved on Ladysmith, and of course it was an exceedingly trying time by reason of the hot weather. In that enormous column of 30,000, the first who dropped out were not the tall men, or the short men, or the big men, or the little men—they were the drinkers, and they dropped out as clearly as if they had been labelled with a big letter on their backs."

Such experiences prepare us for the conclusion that alcohol should be avoided by the athlete in training. Professor Woodhead, himself in his day a noted athlete, is emphatic on this point. That all, however, do not share his view is shown by the fact that the University crews while in training are allowed a limited quantity.

What constitutes a moderate quantity of alcohol?—It is very necessary to define what we mean by "moderation" in regard to alcohol, for the term is an elastic one and susceptible of widely different interpretations. Presumably the physician means by a moderate quantity of alcohol one which is harmless. Hence the important question we have to decide is—What constitutes the maximum daily amount that can be taken without injury? Is it, say, two wineglasses of whisky, or their equivalent? Or is it some smaller quantity? At best this question can only be answered approximately. Even if we had at our command—which we have not—the data to furnish an answer to it, that answer could not state a rigidly fixed amount.

It would not suffice to say, categorically, that exactly so much alcohol is the maximum daily quantity that this, that, or any man can take with impunity. Our answer must take into account a number of points. For example, alcohol acts much more injuriously on the sedentary than on those leading an active outdoor life. Again, the effects of alcoholic drinks depend largely upon the kind of beverage consumed ; malt liquors, wines, spirits, all have their peculiar effects, effects which cannot accurately be measured by the mere amount of alcohol they contain. Moreover, the effects of these various drinks vary with their quality. Three glasses of a well matured whisky are less injurious than one glass of the raw spirit, and several glasses of good old port than a single glass of adulterated stuff. Finally, the important factor of idiosyncrasy has to be reckoned with. Some people are made ill by even moderate quantities of alcohol in any form, and the wiser among them soon get to recognize the fact ; on the other hand, there are those who can imbibe quite large quantities with apparent impunity. We meet with men of fourscore years and upwards who continue to take their daily bottle of champagne or port, and although most, if not all, of them would probably enjoy better health on a less liberal allowance, it is evident that they belong to a class which is peculiarly tolerant of alcohol. Thus it is clear that, even if we possessed accurate data regarding the effects of alcoholic drinks on health and longevity, the term "moderate drinking" does not admit of a rigid definition applicable to all. We cannot say, for instance, that one glass of whisky, or a pint of ale, or two glasses of port, even supposing them to be of sound quality, will constitute moderation for all alike, seeing that one person may be intolerant of all of these drinks, another may be intolerant of the port but not of the champagne, a third may tolerate port and champagne, but not ale, and a fourth may be able to take all three alone, or combined, and yet seemingly remain quite well. Our definition must therefore be couched in some such terms as the following : A moderate daily allowance of alcoholic drink for any given person is the maximum quantity (or any quantity below this) of such alcoholic drink as best suits him that can be taken without producing any appreciable harm.

This definition is, however, of little use for practical purposes, because very few people will take the trouble to test whether the alcohol they take *is* doing them harm. It should be remembered that our feelings are not a safe guide in this connexion, and that even though a person may claim to feel perfectly well while drinking alcohol, his tissues may all the time be undergoing insidious injury.

The only available method of estimating what constitutes the harmless maximum is by studying the influence of alcohol on length of life. Obviously the harmless maximum, as judged by this test, is the largest daily quantity of alcohol which can be taken without shortening life. That the inordinate consumption of alcohol shortens life is well known: no Insurance Company will accept the life of a confirmed drunkard. Insurance tables show that the average expectancy of total abstainers is considerably greater than that of non-abstainers, and many offices insure the latter at a reduced premium. We cannot, however, draw any conclusion from this as to the influence on length of life of the strictly moderate indulgence in alcohol, for many of those who are insured as non-abstainers but who regard themselves as moderate drinkers, certainly take very much more than is good for them—perhaps three-quarters of a bottle of whisky, or its equivalent, daily. It has to be remembered that nothing short of unmistakable inebriety would, so far as alcohol is concerned, be considered a bar to the acceptance of a life, and further that not a few who are strictly temperate when first insured subsequently drift into excess. It is evident that what we want is a comparison between total abstainers and strictly moderate drinkers.

An eminent physician, many years medical adviser to an Insurance Company, assures us that at its offices the greatest care is taken not to accept the lives of any non-abstainers but the most severely temperate, and that in spite of this the mortality of the total abstainers is found to be considerably below that of the temperate drinkers. This shows that what is regarded as strictly temperate drinking tends to shorten life, but it gives us no indication of what constitutes the harmless maximum for the average individual.

One way of discovering this would be for some Insurance Company to split up the insurable non-abstainers into two classes

—the moderate and the very moderate drinkers, and then to compare the mortality of the two. Of course in order to carry out this experiment successfully, the term "very moderate drinker," would have to be accurately defined, those insuring under this head having to guarantee, say, never to take more than one glass of sound whisky, or its equivalent, daily.[1]

The position of the medical man in regard to the question of alcohol.—The public look to the medical man for guidance on the thorny question of the use of alcohol, and it is very desirable that he should be able to speak *ex cathedrâ* in regard to it. Unfortunately, medical opinion is much divided on this subject, some authorities holding that alcohol is an altogether evil thing, to be avoided at any cost, others that in moderation it actually does good.

We must be careful not to approach the question in any partisan or prejudiced spirit—a not altogether easy matter, since those who have been brought up among total abstainers are apt to regard alcohol as an unmitigated curse, while those who have been accustomed to its use from early years are apt to think that no self-respecting person should go without it. Opinions thus founded are, however, mere impressions; they have no scientific basis; they must not content the medical man, who, casting aside all prejudice, must endeavour to arrive at the truth by scientific methods. But at whatever opinion he arrives, let him be careful not to take up an extreme or impracticable position. If he sees reason to uphold the use of alcohol he must not denounce the abstainer as a mere crank; nor, on the other hand, should he press his views extravagantly, though he be convinced that in total abstinence lies the only safety. If he is wise he will bear in mind the fact that alcohol has "come to stay" among

[1] We ourselves regard the plan here suggested as practicable. If it is possible to rely upon the good faith of the total abstainer, it is surely possible to rely on that of the very moderate drinker. There are many such who are all but total abstainers, but who do not wish to be deprived of the liberty of taking alcohol upon occasion, and who cannot therefore be insured under the more liberal terms granted to total abstainers. It would be more equitable if the premium on such lives were reduced and that on the lives of the less temperate of the non-abstainers increased, for there can be no doubt that among these latter there are many who shorten their days considerably by immoderate drinking.

civilized mankind and that no amount of coercion or persuasion can banish it from our midst; and he will also reflect that even if it could be proved up to the hilt that alcohol in small quantities is harmful, it is very doubtful whether an unreserved condemnation of it is justifiable. Granted that it does some harm, it cannot justly be denied that it also possesses the virtue of creating pleasurable emotions, and we should assuredly think many times before we decide to rob a creature, born, like man, inevitably to a certain share of pain and sorrow, of the temperate employment of any means of mitigating these and adding to his joy in life. While, therefore, the medical man should fight with all his might against the abuse of alcohol, he should, even though a firm believer in the advantages of total abstinence from a severely hygienic standpoint, look with a kindly eye on the moderate drinker, bearing in mind that while the abuse of alcohol leads to misery, degradation, and crime, the temperate employment of it may add not a little to the fund of human happiness.

Taking then, this general attitude to the question, our summing up as to the advisability of the use of alcohol by the average individual will be somewhat as follows:—Alcohol does not in the healthy promote health, and while it is doubtful whether, when consumed in a quantity short of what is manifestly injurious, it can justly be regarded as a food, its food value is in any case no more than the equivalent of a very small amount of sugar or fat. Since, though not yet experimentally proved, it is probable that the daily consumption of any but very moderate quantities tends in most cases, if it affect health one way or the other, to affect it injuriously and to shorten life, we can only sanction the use of alcohol on the clear understanding that, except in disease, it is *as a luxury, not as a necessity.* Provided this fact is clearly recognized, we may countenance the moderate employment of sound alcoholic beverages in the case of those who can afford them, always supposing that no appreciable ill effects (the results of idiosyncrasy) are observed to follow their use.

Circumstances under which alcohol should be forbidden.—The use of alcohol as a matter of routine should not be sanctioned before the age of twenty-one years. Certainly none should be taken at school. A glass of wine may perhaps be allowed on festal occasions at home, such occasional indulgence not only teaching the value of moderation and restraint, but affording opportunity for discovering the existence of a congenital susceptibility towards alcohol—and to be forewarned is to be forearmed.

Except in special cases, those who are already abstainers should be encouraged to remain abstainers.

Degenerates of all kinds, and those, whether degenerate or not, with a family history of inebriety, should be urged to be lifelong abstainers.

In advising as to the use of alcohol the question of expense must not, as it too often is, be ignored. With many it is a consideration of the first importance. A married man earning, say, a pound a week, can ill afford the luxury of alcohol. If he and his wife spend four pence a day on drink, an amount which represents very moderate drinking, the weekly drink bill totals two shillings and four pence, or nearly an eighth of the entire earnings. The spending of so large a proportion of the income on alcohol is injudicious, even when there are no children; when there are children, it is unjustifiable. Much, perhaps three-fourths, of the poverty and misery of the masses is the result of their improvidence, and while it is very generally recognized that drunkenness is in large measure responsible for the distress, it is not so well recognized that even the temperate drinkers among the poor spend far more money on drink than their wages justify. It has been calculated that the average sum of money spent each year on alcohol by the working classes in this country, per family of four, is over fifteen pounds. This with interest represents nearly £100 in five years.

While sanctioning the use of alcohol with the above reservations, we insist always upon the importance of drinking none but sound beverages. The poor should avoid spirits. The gin which is largely consumed by the poor women of this country is for the most part of inferior quality, and the whisky, which is the more popular spirit with the men is, as obtained on draught at the public house, a still more pernicious drink, seldom being much more than a year old, whereas it is not fit for consumption until at least eight years after distillation. Beer, again, the most popular of all alcoholic drinks with the English proletariat, often leaves much to be desired in the matter of purity. With this, as with their other alcoholic beverages, the poor show their customary improvidence. If obtained by the barrel—a practice contrary to their hand-to-mouth methods—a sound beer can be got for a shilling a gallon, which is at the rate of three halfpence a pint, i.e. less than half that charged at the public house, where they get an inferior and often adulterated article. Similarly, by buying his whisky by the bottle the working man could secure the very best kind at a lower price than he gives for his nips of raw poisonous spirit at a bar. Unfortunately he often has so little self-restraint that even if he possesses the foresight to store his own liquor, he cannot trust himself with a supply always ready for use.

Quantity of alcohol permissible.—Speaking generally, we may say that a daily allowance of a wine-glass of whisky, or a couple of glasses of port, or a pint of mild ale, constitutes strictly moderate drinking. Many who would indignantly repudiate the charge of excess greatly exceed this amount; indeed, it is possible for a person to be a heavy drinker without in any way realizing the fact. We have been informed that a large number of Englishmen in India daily consume, in repeated nips, three-quarters of a bottle of whisky, though probably but a few of them realize that they are taking so much: it is surprising how occasional drinks mount up. No one should be under any kind of misapprehension as to the quantity of alcohol he takes, but should have the precise amount clearly present to his mind: self-deception on this score must be carefully guarded against.

But even when the moderate daily allowance for the many has been arrived at, a variety of circumstances still demand consideration.

Thus, idiosyncrasy has to be taken into account; some, as before said, can consume with apparent impunity an amount which is manifestly injurious to others. Here personal experience has to be appealed to, care being taken that no self-deception is practised. The allowance should be limited to a quantity that does not, so far as can be observed, produce any ill effect. The influence of climate and mode of life has also to be considered;

in the tropics and in very cold regions it is best to avoid alcohol altogether. To those living an active out-door life a more liberal allowance can be permitted than to the sedentary and confined. Nor in this connexion must the dietetic factor be neglected : those who over-eat are less able to tolerate alcohol than those who eat moderately. It is therefore even more incumbent on the gourmands than on the moderate eaters to be strictly temperate. Generally it will be found, we think, that those who, in spite of free indulgence in alcohol, live to a ripe old age are abstemious in the matter of diet. It is scarcely necessary to observe that chronic alcoholic excess is more harmful when an insufficient quantity of food is taken than when the dietary is sufficient, but any food beyond the physiological quantity tends to accentuate the evils of alcoholic excess.

The time to take alcohol.—Though in this country it is the custom to take alcohol chiefly with meals, such is not the universal practice. In Australia, for example, it is the exception rather than the rule, and in America the practice is far less common than it is on the continent of Europe. Nevertheless, the best time to take alcohol is undoubtedly with the meals : alcohol is much less apt to do harm when allowed to enter the blood in company with digested food than when it passes into the circulation alone. The practice of taking alcoholic drinks, especially the stronger kinds, on an empty stomach is most injurious. Nor should alcohol be taken early in the day even with food : most people are certainly best without any before the mid-day meal, and those who have to do brain work in the afternoon will generally find it a good plan to go without any at lunch. As to the "night cap," while not condemning it unreservedly, we have no doubt that improvement in health often follows its abandonment. It is scarcely necessary to insist upon the unwisdom, from every point of view, of doing business over a drink.

Kind of beverage to be recommended.—When we sanction the use of alcohol it is, of course, on the distinct understanding not only that the beverages taken are sound, but that they suit the individual. In other words, in advising as to the kind of alcoholic drink to be taken, due regard must be paid to the personal factor ; to some we may find it advisable to recommend malt liquor, to others wine, and to others, again, spirits. Our advice to a patient should be somewhat as follows: "If you have a mind to take alcohol and can afford the luxury, you must be sure that the drink you take is a sound one, but as to the particular kind, you yourself should be the best judge; what you find suits you best is the best for you." Not only do people differ in their toleration of different alcoholic drinks, but it is a common experience that a beverage which agrees at one period of life, does not agree at another. Thus people often find it necessary to abandon malt liquor as they get older, and later, perhaps, champagne as well. They will say, "I cannot take such and such a drink now; I still like it, but it no longer likes me."

Individual experience is, we repeat, the only criterion as to the most desirable form in which to take alcohol. The difficulty of establishing any surer one is shown by the diversity of medical opinion and the influence of fashion in this matter. At one time whisky is all the rage, at another light wines are in vogue; for long past port wine has been taboo, though if properly matured it often agrees well.

In the selection of wines, spirits, etc., it is well for those who are not good judges—and very few are—to get the help of a disinterested expert.

THE THERAPEUTICS OF ALCOHOL

As a **cardiac stimulant** alcohol is of use in syncope and in certain cases of acute fever, such as enteric and pneumonia. In the latter class of case it is chiefly of service in tiding the patient over a temporary danger; it should on no account be given as a matter of routine. The test of its value in such cases is its influence on the pulse, the temperature, and the general condition of the patient: if it slows the pulse, lowers the temperature, and calms delirium, we conclude that it is doing good; but unless there is distinct evidence that it is doing these things, it is best to withhold it, for it must never be forgotten that alcohol not only tends to poison the heart muscle but also to weaken the natural defences of the body against pathogenic bacteria.

When with **hyperpyrexia** there is considerable constriction of the superficial arterioles, as may happen, e.g. in enterica, a preliminary dose of alcohol, by dilating these vessels, may facilitate the reduction of the temperature by means of the cold bath.

Simple uncomplicated cases of pneumonia are best without any alcohol. The like is true of acute bronchitis, especially if the patient is middle-aged and obese ; much more good results from judiciously restricting the food than from plying the patient with alcohol.

While alcohol may be of some service in acute disease, its chief therapeutic use is in chronic states of debility, such as are met with in the anæmic, in the overworked, and in those exhausted by chronic suppuration, or by such diseases as influenza and malaria. It is probable that in all such cases alcohol essentially benefits by stimulating appetite and digestion. It is true that in some it may be quite useless, nay, even harmful, causing headache, flushing, and other disagreeable symptoms, but in others, under the judicious administration of champagne, stout, or port wine, the patient at once begins to make headway.

The following is an illustration of the value of alcohol in promoting digestion in a case of debility from overwork. A busy professional man finds that after a good holiday he is able quite well to dispense with alcohol, but when the effects of his holiday have worn off he generally appears at the luncheon table pale, weary, and overwrought, with no relish for his food, which he swallows mechanically and without feeling any the better for it. If, however, he takes a glass of port early in the meal all this is altered ; he enjoys his food, the blood comes back to his lips and cheeks, and the irritable mood is replaced by one of serene geniality, resulting in a flow of easy and agreeable conversation. In such a case alcohol not only acts as a sedative but also as a stimulant ; it allays irritability and stimulates function. Exactly the same experience is repeated at dinner.

Though alcohol may undoubtedly be useful in cases like this, where the weakness of digestion is part of the general bodily weakness resulting from fatigue, much may be done to revive the flagging energies by other means, such as complete rest of mind and body for twenty minutes before the meal, the slow sipping of some hot stimulating soup or even simple hot water, the taking of a dose of quinine or other vegetable bitter, and finally by bathing the face and neck, or even the entire head, in hot water. The formality of dressing for dinner may go a long way to remove fatigue and to give a zest for the meal.

In fatal diseases which are not likely to run a long course, such as carcinoma and many cases of phthisis, alcohol may often be given with advantage. In so far as it is capable of soothing the incurable patient and giving him a passing sensation of well-being, it should be allowed without hesitation, even though in other respects it may be detrimental.

Alcohol in the form of whisky or gin is often given to relieve dysmenorrhœa, but other and more efficacious remedies are available, and it is not wise to prescribe it for this purpose. Nor should we sanction its use for the relief of "windy spasms," or for the "sinking" feeling at the pit of the stomach so frequently experienced by women, especially at the climacteric. Alcohol undoubtedly relieves these symptoms for the time being, but the practice of flying to it for relief not infrequently eventuates in hopeless inebriety. Most women are best without any alcohol whatever during the climacteric. And here it may be remarked that great caution should be observed in regard to alcohol by lonely childless women. Much alone all day, with perhaps little to occupy them, they form a class peculiarly liable to drift unconsciously into habits of intemperance.

Dosage.—In prescribing alcohol, it is very necessary to give precise directions as to quantity and as to the length of time during which it is to be taken, otherwise we may find the patient taking a larger amount and for longer than we intended.

ARTIFICIAL METHODS OF ALIMENTATION

CHAPTER IX

ARTIFICIAL METHODS OF ALIMENTATION

By Francis D. Boyd, C.M.G., M.D.

In a number of diseases of the alimentary canal the administration of food by the natural channel is either impossible or inadvisable, and the physician must have recourse to **methods of artificial nourishment.** The entrance of food into the stomach may be prevented from mechanical causes, changes in the mouth, e.g. excessive thickening of the tongue or of the gums the result of inflammatory changes or tumour growth, obstruction of the œsophagus either from the pressure of a tumour or from organic changes in the gullet itself, most frequently from carcinoma, or it may be from diverticulum, spasm, or the presence of a foreign body. Again, though there may be no obstruction, the act of swallowing may be so inefficiently carried out through muscular paralysis that some form of artificial nourishment becomes a necessity if nutrition is to be maintained. In certain acute diseases of the stomach the physician desires to secure the diseased organ a period of physiological rest for recovery and repair, and it is sought during this period to maintain general nutrition by means of artificial alimentation.

Artificial feeding may be carried out by the rectum, subcutaneously, or by means of the stomach tube.

RECTAL ALIMENTATION

Nutrient enemata date back to the days of Galen, but it is on the work of Voit and Bauer, of Leube and of Ewald, that most of the modern practice is based. In the early days nutrient enemata were composed of meat broth, milk, eggs, or any other article of food which the physician fancied, and very little trouble was taken to establish the capacity of the intestine for the assimilation of the substances thrust upon it. Now we have more exact metabolic observations on which to base our treatment, and modern pharmacy has given us a number of predigested foods which are more or less easily absorbed.

The composition of nutrient enemata.—Voit and Bauer seem to have been the first to carry out observations on the nitrogenous metabolism of rectal feeding. Working with dogs they found that the absorption of albumin by the bowel was greatly aided by the presence of common salt. Eichorst confirmed these results, and it is now generally admitted that common salt forms an essential ingredient of every rectal injection.

Leube in 1872 published a paper on meat and pancreas enemata by which he claimed to get very favourable results. The enemata consisted of 150 to 300 grammes (4½ to 9 oz.) of finely chopped or scraped meat; 50 to 100 grammes (1½ to 3 oz.) pancreas, finely chopped and freed from fat; 150 c.c. (5 oz.) warm water were added, and the whole stirred into a mushy mass. This was injected by means of a pressure syringe. Leube claims to have got good results; in one case the patient was nourished for six months on the enemata. Riegel speaks highly of Leube's meat pancreas enemata. The writer's experience has been that they are difficult to administer, that the pancreatic value of fresh pancreas is very variable, and that the putrefactive decomposition set up in the intestine is marked and is liable to give rise to unpleasant results. On the whole the method is complicated and not to be advised at the present day.

Huber and Ehrstrom obtained relatively good results by the use of milk, grape sugar and protein, a sugar casein preparation. The composition and method of preparation of the nutritive enemata which have been advised vary greatly. Nearly every writer on disease of the stomach has a formula of his own.

Ewald recommends the following: two or three eggs are mixed with a tablespoonful of cold water, a small quantity of flour is boiled in half a cup of 20 per cent solution of dextrose, and to this mixture a wineglassful of red wine is added; the egg solution is then stirred in, care being taken that the mixture is not sufficiently hot to coagulate the albumen. The whole mass should amount to about ¼ of a litre. The caloric value of such a mixture would amount to 230 to 300 calories.

Boas uses 250 grammes (8½ oz.) milk, 2 egg yolks, a small quantity of salt, a tablespoonful of red wine and a tablespoonful of flour. Riegel employed 250 c.c. (8½ oz.) milk, two or three eggs, a little salt, and one or two spoonfuls of red wine. The use of peptone has been recommended by some writers, but clinical experience seems to show that it is apt to irritate the intestine and cause diarrhœa. The writer has found the following mixture to give good results: the yolks of two eggs, 30 grammes (1 oz.) pure dextrose, ·5 grammes (8 grains) common salt, pancreatized milk to 300 c.c (8–10 oz.). The nutrient value of such an enema equals 300 calories, and given every six hours the total nourishment injected would equal 1,200 calories. Absorption under most favourable circumstances might equal 500 calories, but would most probably be much less. The caloric value might be increased by the addition of an artificial protein preparation such as sanatogen, plasmon, or protene, preparations for which rapid absorption is claimed.

The patient.—In carrying out a course of rectal feeding the preparation and adequate nursing of the patient are very essential factors. Under the conditions where rectal feeding is used, thirst is a prominent feature, and the patient should be allowed a mouth wash, or water to rinse out the mouth, but should be cautioned against swallowing the water. If gastric rest is desired the sucking of ice and the swallowing of water must interfere with gastric rest, for water is not absorbed from the stomach and must be passed on for absorption in the intestine. If thirst be a distressing symptom a normal saline injection should be given. In cases of gastric hæmorrhage oral sepsis is common, the patient should therefore be provided with an antiseptic mouth wash, and great care taken in the cleansing of the buccal cavity. The products of decomposition in the mouth if swallowed are apt to interfere seriously with gastric rest, and to prolong gastric irritation. The rectum and lower bowel must be washed out daily with a simple saline injection; indeed some writers advise this should be done before each nutrient enema, but this seems scarcely necessary. If, during the treatment, rectal irritation and diarrhœa should supervene, a drachm or two drachms of laudanum may be added to each injection, or a morphia suppository used. The **method of administration** and **size of the enema** are important points. The enema should be given with the patient lying on the left side and the hips elevated, or on the back with the buttocks raised. A syringe should not be used, as a substance rapidly injected into the bowel will be as rapidly returned. The enema should be very slowly syphoned in by means of a soft rubber catheter and a small sized filter funnel. The retention of the nutrient material is not then a matter of difficulty. The patient should be cautioned to remain very still after the nutrient injection has been given. The amount of the nutrient injection commonly used is four to six ounces (112 to 168 c.c.), which is possibly too small an amount. If the enema be given slowly 8 to 10 oz. (250 to 300 c.c.) can often be retained, the patient absorbs at least some water, and does not suffer thirst, which is a prominent difficulty when small injections are used. Large injections do not require to be so frequently repeated, a distinct advantage when gastric rest is desired, for it must be remembered that the injection of nutrient material into the lower bowel excites gastric secretion. This gastric secretion, long recognized clinically, has been clearly demonstrated by Umber on a patient on whom gastrostomy had been performed. After a nutrient rectal injection it was found that there was free gastric secretion with a total acidity of 30, free hydrochloric acid equalling 20. Gastric secretion is accountable for the gastric pain and vomiting which are sometimes such prominent features during a course of rectal feeding. Some clinicians have advised that with every rectal injection a small quantity of milk and bicarbonate of soda should be given by the mouth to satisfy the acid secretion and obviate pain.

It is a popular belief that substances injected into the lower bowel are absorbed below the ileo-cœcal valve, but this does not seem invariably to be the case. Insoluble substances injected into the rectum may, under favourable circumstances, reach the stomach. Cannon's observations would support this view. Grutzner has shown that if starch emulsion be injected into the rectum, along with normal saline solution, starch granules can be washed out of the stomach four to six hours afterwards. Church records a case of duodenal fistula where the soap and water of the enema invariably flowed through the fistula. The passage of the nutrient material through the ileo-cœcal valve may account for the favourable results in some cases of rectal alimentation, and is an argument in favour of increasing the size of the nutrient enemata when the patient can tolerate the larger injections. That the ileo-cœcal valve will permit the passage of fluid in every case cannot, however, be expected; in fact the writer has frequently failed to find insoluble particles, such as charcoal, in the stomach washings in cases where charcoal was added to the nutrient enemata.

THE METABOLISM OF RECTAL FEEDING

Absorption of albumin.—Most of the teaching on the absorption and metabolism of albumin is based on Ewald's work. Ewald's results are expressed in the form of a graphic chart, which, though at the first glance it appears very convincing, is in reality very complicated and difficult to follow. The data given do not seem sufficient to form a metabolic profit and loss account, and by recent work the results claimed seem to be quite exceptional. Plantenga found a very small absorption of albumin from the bowel even when salt was added, and Markwald came to the same conclusion. Plantenga in a second communication investigated the absorption of somatose from the lower bowel of a dog, and found an absorption averaging from 10 to 24 per cent. Edsall and Miller studied two patients very fully and found that the nitrogen absorption per diem equalled in the first case 3·04 grammes nitrogen or 19 grammes of protein, while in the second it equalled 3·8 grammes of nitrogen or 23·816 grammes of protein. There seems thus to be a concensus of opinion that albumen is but poorly absorbed even when predigested and when salt is added.

The writer in conjunction with Miss Robertson carried out a series of observations on six cases of gastric ulcer treated by rectal feeding, when a period of complete gastric rest seemed necessary as a therapeutic measure. In these cases the nutrient enema was carefully pancreatized before administration, and a complete analysis was made of the nutrient injections and of the urine and bowel contents. In every case the period of observation lasted over six days. On these observations the tables given are based. The figures in tables show the averages over the periods of observation expressed in grammes per cent.

TABLE I.

Table to show protein and nitrogen of food and protein and nitrogen absorbed, with caloric value of absorption as average per diem :—

Enema.			Absorption.[1]		
Observations.	Protein.	Nitrogen.	Protein.	Nitrogen.	Caloric Value.
I. . .	71·43	11·43	9·52	1·54	39
II. . .	41·62	6·66	6·87	1·098	27
III. . .	49·06	7·85	10·52	1·7	43
IV. . .	46·75	7·48	3·86	0·618	15
V. . .	29·71	4·69	8·62	1·38	35
VI. . .	30·6	4·9	13·87	2·22	56

In observations 1 to 4 inclusive considerable amounts of protein were given (two eggs in each injection). In observations 5 and 6 the white of one egg was used along with milk. In all the observations the amount of protein absorbed is remarkably small. In observation 4, a poorly nourished and somewhat nervous subject, the amount absorbed is particularly small. In observations 5 and 6 where a smaller amount of protein was given in the injection, the absorption was just as good as when a larger amount was given ; in fact, in observation 6 the absorption of protein was better than in any of the preceding cases, and this notwithstanding the fact that milk was used in the enema. Milk is generally considered, except by Aldor, to be a food-stuff very poorly assimilated by the bowel in rectal feeding.

[1] Caspari in a recent physiological study on Vegetarianism (*Pflüger's Archiv*, Bd. 109, 1905, s. 533) calculates that the amount of nitrogen contained in the digestive secretions equals 0·38 grammes per diem. If this observation be correct, and if it applies to cases under rectal feeding, it would increase the nitrogen absorption by that figure. The tables have not been calculated on this basis, as we have no sufficient evidence of the digestive secretions under rectal feeding.

TABLE II.

To show absorption of nitrogen per kilo of body weight :—

Observation.	N. absorbed.	Body Weight.	N. absorbed per Kilo.
I. . . .	1·54 grm.	51·5	0·029 grm.
II. . . .	1·09 ,,	46·5	0·0234 ,,
III. . . .	1·7 ,,	48·9	0·035 ,,
IV. . . .	0·61 ,,	50	0·012 ,,
V. . . .	1·38 ,,	45	0·03 ,,
VI. . . .	2·22 ,,	45	0·049 ,,
Average . .	1·42 ,,		0·0297

When the absorption of nitrogen is considered as per kilo of body weight per diem, it is seen to be very small indeed. When one looks into the literature of the subject it is remarkable on what a small absorption of nitrogen, nitrogenous balance can be kept up in individuals who have become accustomed to a nitrogen-poor diet. Thus in six individuals on a nitrogen-poor diet observed by Hirschfeld, Kumagawa, Klemperer, Sivén, and Albu, the average nitrogen absorption per kilo of body weight amounted to 0·116 grammes per diem, and these individuals were kept in nitrogenous balance. In Sivén's own case indeed the intake of nitrogen was only 0·08 grammes per kilo of body weight, and nitrogen balance was kept up for a short time at least.

Table II shows the nitrogen absorption obtained per kilo of body weight. It averages 0·0297 grammes over the six cases, a figure far below even the minimum absorption, when nutrition balance was kept up in individuals used to a nitrogen-poor diet.

Table III shows the nitrogen balance in six cases of rectal feeding. In all it is seen to be markedly negative. The patients were losing nitrogen from the tissues.

TABLE III.

Nitrogen balance :—

Observation.	N. absorbed.	N. of Urine.	Balance.
I. . . .	1·54 grm.	3·27 grm.	− 1·73
II. . . .	1·098 ,,	5·5 ,,	− 4·408
III. . . .	1·7 ,,	2·4 ,,	− 0·98
IV. . . .	0·61 ,,	6·31 ,,	− 5·69
V. . . .	1·38 ,,	6·87 ,,	− 5·49
VI. . . .	2·22 ,,	8·12 ,,	− 5·89

From these observations it may be concluded that :—

1. Protein food, even when predigested and with salt added, is very poorly absorbed in rectal feeding.

2. The albumin of eggs, as generally used in rectal feeding. is a very expensive and unsatisfactory food-stuff.

3. There is no relation between the amount of protein injected and the amount absorbed. Absorption seems to depend more on the patient's individual capacity for absorption than on the amount of protein food given.

Absorption of fat.—Much of our knowledge of the absorption of fat is based on the work of Munk and Rosenstein. Their observations were made on a patient with a lymph fistula through which the absorbed chyle could be collected. The patient was kept on a fat-poor diet, and then given enemata of an emulsion of 15 grammes of lipanin, in 0·4 per cent saline solution. The lymph showed a rise in fat contents of from 0·18 to 0·45, that is to say, 3·7 per cent of the oil was absorbed. In the second observation the fatty content of the hunger-lymph was estimated, a cleansing injection was then given followed by an enema of 20 grammes of lipanin in soda solution. The lymph showed a rise in fat from 0·06 to 0·37 per cent, and after 9 hours was still 0·23 per cent. There was absorption therefore of 5½ per cent of the fat of the enema. Robert and Koch found that emulsified fat was slowly absorbed in small quantities, while unemulsified fat was but little absorbed. Munk and also Armschink found that the lower the melting point of the fat the better it is absorbed. Deucher concludes that 10 grammes of fat per diem are absorbed with difficulty even in favourable circumstances, and that the best results are got by the use of small quantities retained in the colon a long time, and with salt added to the injection.

TABLE IV.
Table to show absorption of fats as average per diem.

Observation.	Fat of Enema in Grm.	Fat absorbed in Grm.	Percentage of Absorption.	Caloric Value.
I. . .	103·37	45·85	44	426
II. . .	47·44	23·87	51	222
III. . .	40·24	14·46	35	134
IV. . .	39·61	5·45	12	50
V. . .	9·18	−2·55	—	−23·71
VI. . .	14·35	3·47	24	32

In these observations the fats were estimated by weight after extraction with ether, so that the resulting figures may be more correctly termed ether soluble bodies. The results obtained differ materially from those of Deucher. They show a definite relation between the amount of fat given and the amount absorbed. The maximum of absorption, 45 grammes in observation 1, was where the maximum 103 grammes were given in 24 hours. Considerable fat absorption was got whenever a large amount of fat was used in the enema. In observation 4 a small amount was absorbed, namely, 5·45 grammes, equal to 13 per cent., as compared with observation 3, where, with practically the same amount, in the enema, a considerably larger quantity was absorbed. It is to be noted that the patient in observation 4 was poorly nourished and exceedingly emotional and that albumin was equally badly absorbed. Observation 5 is difficult to explain; the amount of fat recovered from the stool was greater than the amount injected by an average of 2·5 grammes per diem. The patient was a very well-nourished but somewhat chlorotic young woman. One can only conclude either that her fat absorption was practically nil and that the surplus amount recovered was accounted for by the digestive secretions, or that some unauthorized article of food was taken by the mouth. The latter explanation was indignantly denied by the patient, and considered impossible by the nurses in charge, and is not borne out by the figures of the nitrogen and sugar metabolism.

TABLE V.

Table to show loss of nitrogen of tissues and loss of weight in relation to fat and sugar absorption as average per diem by the patient.

Observation.	Nitrogen of Tissues.	Loss in Weight in Kilos.	Fat absorbed.	Sugar absorbed.	Caloric Value of Absorption
I.	1·73	0·378	45·85	43·8	606
II.	4·4	0·245	23·87	38	378
III.	0·98	0·405	14·46	61·85	388
IV.	5·69	0·518	5·45	50·61	258
V.	5·49	0·583	– 2·55	81·1	308
VI.	5·89	0·778	3·47	36·96	184

In glancing at Table V it is interesting to note that fat absorption seems to play an important rôle as a nitrogen-saver. The loss of tissue nitrogen for the six observations is very much larger in those where the fat absorption is poor. Taken as a whole the figures show that emulsified fat is a very useful ingredient in rectal enemata, and is very much better absorbed than is generally considered.

Absorption of sugar.—The absorption of sugar has been studied by Voit and Bauer, Schoenborn, Strauss, Leube, Plantenga, Deucher, Zehmisch, and others. Deucher gave a patient during nineteen hours five enemata containing each 40 grammes sugar, and got an absorption of 77 per cent, that is to say, 154 grammes were absorbed. Plantenga working with smaller quantities got good results. Zehmisch giving 152 grammes per rectum got an absorption of 103 grammes. In these observations conclusions were drawn from the amount of sugar or dextrine recovered from the stool, that is to say a known quantity of sugar was given by the bowel, the sugar in the fœces estimated and the difference taken as the measure of absorption. Exception has been taken to this method of observation. It has been urged that under the influence of micro-organisms sugar is split up, and is absorbed or passed in the stool as the products of bacterial action, so that what disappears from the bowel contents has provided no nutriment for the patient. This view is supported by Reach. He shows that 60 grammes dextrine given by the mouth has the effect of raising the respiratory quotient, while the same amount given by the bowel does not definitely raise it. He considers that the amount of sugar absorbed by the bowel is very considerably below the amount absorbed when given by the mouth. Dextrine, he finds, is better absorbed by the bowel than sugar, and does not irritate the bowel to the same extent.

It seemed of interest to ascertain how far sugar was broken up by the influence of the micro-organisms of the bowel, and especially the bacillus coli communis, the most important micro-organism of the intestine. It was found that the loss of sugar reached a maximum after four or five hours of incubation. A large number of observations were carried out. In all the loss of sugar was below 1 per cent ranging from 0·49 per cent to 0·77 per cent. With the exception then of Reach's observations, which cannot be accepted as conclusive, the objections to the use of sugar as not being utilized, but as being split up before absorption, are wholly theoretical. The amount lost by bacterial action seems in reality but small, in fact, below 1 per cent. In support of this view, one may cite the observations of Kausch and Socin, who have demonstrated on animals that milk sugar and galactose, when given by the bowel, appear to enter the liver, and are converted into glycogen.

TABLE VI.

Table to show absorption of sugar as average per diem.

Observation.	Sugar of Enema.	Sugar Absorbed.	Caloric Value.
I. . . .	47·75	43·8	179
II. . . .	38	38	155
III. . . .	61·85	61·85	253
IV. . . .	57·12	50·61	207
V. . . .	88·14	81·1	332
VI. . . .	39·08	36·96	151

In the clinical cases pure dextrose was used. Table VI shows the results obtained. In all the cases the absorption appeared good. In observation 3 where 61·85 grammes were given daily, all appeared to be absorbed. In observation 5, 88 grammes were given, and 81 absorbed. The absorption seems to vary in the different cases, not with the amount given but rather with the varying capacity of the individual for absorption.

The caloric value obtained from the use of sugar ranged from 151 calories as a minimum to 332 calories as a maximum. In none of the cases was there any irritation produced by the dextrose, a disadvantage which has been urged against its use. In no case did alimentary glycosuria result.[1]

Table VII shows the relation between the caloric value of the food given, the caloric value of the food absorbed, and the loss in the patient's weight. The table seems to show fairly conclusively that the observation data may be considered accurate.

[1] The absence of bowel irritation was probably due to the use of pure dextrose. Commercial dextrose may contain impurities, such as sulphuric acid, which would induce bowel irritation.

TABLE VII.

Relation between food calories used and loss in patient's weight average per diem.

Observation.	Food Calories.	Calories Used.	Loss of Weight in Grammes.
I. . . .	1,777	645 = 35 per cent.	367
II. . . .	939	405 = 48 ,,	246
III. . . .	869	431 = 49 ,,	405
IV. . . .	894	273 = 30 ,,	519
V. . . .	567	344 = 60 ,,	584
VI. . . .	428	240 = 56 ,,	892

The figures in column 1 diminish from above downwards, so that in observation 1 a much larger amount of food was given than in observation 6. Column 2, showing the calories used, diminishes from above downwards, but it is to be noted that the percentage absorption is not in proportion to the amount given. In observation 1 while 645 C. were absorbed (equivalent to only 35 per cent of the food given), the wastage was large. In observation 5 while only 344 C. were absorbed, the absorption equalled 60 per cent of the food given. The loss in the patient's weight increases from above downwards in the table. When little food was absorbed, as in observation 6, in which only 240 C. were absorbed, the loss in weight is greatest, equalling 392 grammes per diem.

Clinical deductions.—The important point for the clinician is, Can rectal feeding be relied on as a means of nourishing a patient if gastric rest is indicated as a therapeutic measure, or can it be relied on to improve nutrition in a case where buccal feeding is inefficient or impossible ? The caloric value of the food absorbed in the investigations quoted varied from 645 calories as a maximum to 240 calories as a minimum, giving an average of 389 calories. Thus we get from rectal feeding only about a quarter of the nourishment required to maintain equilibrium, even if a reduced standard of nutritive requirements be accepted. In considering these cases it must be remembered that they were all cases in which rectal feeding was well borne, so that the conditions were in fact favourable to food absorption. If the rectal feeding was not well borne, if diarrhœa or vomiting was at all a prominent symptom, or if the patient's nutrition was obviously suffering under the rectal feeding, other methods of treatment were adopted and the observation was not included in the series. From the metabolic work which has been done on rectal feeding it must be concluded that even under the most favourable circumstances it is sub-nutrition of a most pronounced character. Given a patient in poor condition it cannot be relied on alone to produce any material improvement in nutrition. This seems an important point to emphasize. The surgeon frequently wishes to have a patient suffering from œsophageal or pyloric obstruction brought into a condition of improved nutrition before operation. It cannot be too strongly emphasized that rectal feeding cannot be relied on to produce this result. It will at once be urged that patients have been known to gain weight under rectal feeding. In considering this the absorption of water from the intestine must be remembered. After severe hæmorrhage or persistent vomiting, as in pyloric obstruction or gastric ulcer, the tissues are suffering markedly from want of water. On placing the patient on rectal feeding, water is absorbed and there may be a gain in weight. In one case which the writer studied, where rectal feeding was begun after a very severe hæmorrhage, though the nitrogen balance was markedly negative, yet there was a distinct gain in weight after nine days rectal feeding.

If the physician desires to make use of rectal alimentation, it seems that the best results will be got from the carbo-hydrates and fats. The absorption of protein food from the bowel is so small as to make it of little value as a food-stuff.

Folin has recently enunciated a theory of protein metabolism which would place protein on a much lower plane as a food than it has up to the present occupied. He regards proteins, in fact, as of secondary importance, insomuch as their nitrogen is split off and eliminated, leaving the carbon and hydrogen containing part to be oxidized, and thus to yield energy as it is yielded by the carbo-hydrates and fats. Folin's views have not so far met with general acceptance (Paton), but even without accepting Folin's views, we may evidently with advantage abandon much of the nitrogenous material which is at present used in rectal alimentation.

There remain then the carbo-hydrates and fats. The best carbo-hydrate to use is pure dextrose, but failing it dextrine is always available, and is probably better than a crude sugar, in that the latter may contain impurities which may cause bowel irritation. Fat is best given in the natural state, as in yolk of egg. If prepared fat is used, it should be in the form of a fine emulsion of a fat of low melting point. Pure olive oil can be used, a little being saponified and used to emulsify the whole. The difficulty in regard to fat in rectal feeding seems to be the wide difference in the absorptive power of different individuals for fat. When well absorbed it is a most valuable source of energy, but the absorption cannot be foreseen in any given case.

The conclusion to which a study of the metabolism of rectal feeding leads seems to be that its field of usefulness is more limited than is at present recognized by clinicians. In acute gastric diseases it must interfere with complete gastric rest by inducing gastric secretion. It must, however, be remembered that while the amount of nourishment absorbed is not sufficient to keep the patient in nitrogen balance, it may be sufficient to tide over a critical period and to prevent an undue strain upon the tissues. It is a dietetic means of treatment which, used with intelligence, will prove helpful alike to the patient and to the physician.

SUBCUTANEOUS FEEDING

When nourishment by the ordinary channel is contra-indicated or impossible, rectal alimentation may be impracticable from disease of the bowel preventing the retention of the nutrient injections, or, as in the case of the insane, from the inability of the patient to aid the physician in carrying out the treatment. Under such circumstances it has been sought to maintain nutrition by the subcutaneous or intravenous injection of food-stuffs. There are a number of early and tentative observations on this method of feeding. Thus in 1850 Hodder made intravenous injections of milk in cholera patients apparently with favourable results. In 1869 Menzel and Perco experimented with the subcutaneous injection of food-stuffs both in dogs and in man. These observers were followed by Karst, Krueg, Whittaker, Pick and others, but it is to Von Leube that we owe the demonstration of the *apparent* utility and simplicity of the method, both from the experimental and from the clinical aspect. It is at once obvious that certain food-stuffs are incapable of use by this method, either because they are not directly assimilable, or because their solutions are incapable of proper sterilization. Thus though Leigh has claimed good results from the injection of white of egg, there is no proof of its assimilation, and the sterilization of the solution presents great practical difficulties. Albumoses and peptones, while their solution is easily sterilized, are foreign bodies in the blood, are toxic, and are excreted by the kidneys and produce much irritation during their excretion. Leube found that albumoses were assimilable up to a certain point, but beyond this produced toxæmia and albuminuria. The injection of a solution of 270 grains of somatose into a large dog produced a lowering of the general health with albuminuria and nephritis, Alkali-albumin when injected is apparently assimilated, but its injection causes marked irritation, and the solutions are difficult to sterilize. Blood serum has been used by a number of observers, but the nutritive result obtained from the injection has not been great. It was found experimentally that if the serum of one animal were injected into another it proved toxic, but if the serum had previously been treated by prolonged heating at a temperature of 58 to 60° C. it became opalescent, but did not coagulate, and no longer produced toxic symptoms when injected. Clinically serum injections have been made use of by Reinach and by Salter, but while the serum seems to have been metabolized and no ill effects have followed the injection, the nutritive result obtained has never been sufficiently great to justify their extensive use as a method of artificial feeding in clinical work. So far then the use of protein solutions for subcutaneous injection has not proved encouraging. Until we get a protein body which in solution is non-irritating, and is capable of sterilization and of assimilation after injection,protein must be abandoned for subcutaneous nourishment.

The use of **carbo-hydrate solution** would at first sight appear both promising and rational, but the result obtained has not been much more satisfactory than in the use of protein. Voit found that subcutaneous injections of sugar were slowly absorbed, and hence the tissues were saved from sudden flooding with carbo-hydrate, and that even with large injections glycosuria was but trifling. Two ounces of dextrose could be injected with only traces of sugar appearing in the urine, while if three ounces were injected only about half a drachm of sugar passed out by the kidneys. The injections of concentrated solutions of sugar are, however, liable to cause marked pain, and necrosis of the skin has resulted. Strong solutions of sugar cannot, therefore, be used. To be free from pain and discomfort a subcutaneous injection must be isotonic with the blood. This in the case of glucose is a 5 per cent solution. A pint of this solution can be injected without subsequent discomfort. The nutrient value of such an injection is approximately 102 C. Barker claims very good results from the use of such injections in exhausted surgical cases as regards the condition of the pulse, the general strength, and the relief of thirst. Considering the nutrient value of the injection, much of the benefit obtained must, however, be attributed to the water infused. A patient's nutrition cannot be kept up on injections the value of which in the twenty-four hours may reach 204 C. Still, such injections may be of use in tiding over a critical period of illness.

The use of protein and of carbo-hydrate for subcutaneous injection having proved of no great nutritive value, it is natural to turn to **fats** in the hope that better results might be obtained. Fat has a high energy value. In starvation the fat depôts are called upon to provide energy and to save tissue protein. By increasing subcutaneous fat by injection good results might be hoped for in cases of subnutrition, where food could not be taken in sufficient quantity by the mouth. Much work on this line has been done by Leube. He found that fat injected under the skin was slowly absorbed in the form of a soap and that fat embolism was not to be feared. Working with dogs, he proved that butter injected under the skin was stored in the omentum as dog fat. Koll, working at the gaseous interchange and nitrogenous excretion after fat injections, showed that the fat acted as a protein sparer and was for the most part used by the animal. Leube has used the method extensively in clinical work, and claims that if not more than 40 grammes (10 drachms) be injected at a time there is no pain, no inflammatory reaction, and if antiseptic precautions be observed, no untoward after-effect. Absorption of the fat takes place in 12 to 24 hours. Jakob injected much larger doses, 7 to 10 oz., without pain, and similar results were got by Du Mesnil de Rochemont. He used large injections of olive oil and satisfied himself that the fat was absorbed, slowly undoubtedly, and was made use of in the body, so that it could be counted on to spare protein metabolism. These larger injections have, however, the disadvantage of causing considerable pain and discomfort to the patient.

Much of the value obtained from fat injections must depend upon the rapidity of absorption, and it is in this that the method seems to fail. Winternitz has recently discussed the question from this aspect. The observations were carried out with a combination of fat and iodine (iodipin). The metabolism of the fat resulted in the liberation of the iodine which could be recovered from the urine. The results seem to show that fat is very slowly metabolized when injected under the skin, and that even after large injections and when absorption is relatively rapid only half a drachm to one drachm can be metabolized per diem. Thus if a large injection be given, months may be required for its metabolism. The most that can be expected is a daily energy value of 20 to 25 calories from fat injections. Winternitz's results if confirmed tell heavily against the usefulness of fat injections in clinical work where rapid results are desired, and prove the uselessness of large injections.

The technique of fat injections is very simple. Elaborate apparatus is unnecessary. The oil, preferably pure olive oil, is sterilized by heat. The point selected for the injection, the subcutaneous tissue of the mammary region, of the abdomen, or thigh, is carefully cleansed. The injection is given very slowly by means of a large syringe, two or three ounces being injected daily. It is of great importance to give the injection slowly; for this reason some advise the use of a pressure bottle and trochar. The trochar is introduced, the pressure is raised in the bottle and the oil slowly flows into the tissues. However the injection is given, it is not free from considerable discomfort to the patient, which may last for some hours, even if the oil is diffused by gentle massage. It must always be remembered that the material injected is a nitrogen-free food, and in spite of the apparent favourable results obtained by some observers accurate metabolic observations show that the injections have but little nutritive value.

FEEDING BY THE STOMACH TUBE

Feeding by the stomach tube is employed in mental cases where food is refused, for sufferers from muscular paralysis, when swallowing becomes impossible, and in certain affections of the tongue, of the pharynx, and of the œsophagus which render deglutition painful or impossible.

By means of the tube food is poured directly into the stomach two or three times in twenty-four hours. Eggs, milk, soup, beef juice, and solutions of peptone are suitable foods. The stomach can easily take a quart of such liquid nourishment, but it is most desirable that the food should be introduced slowly.

Gavage is a term first used to signify the introduction of food into the stomach by means of a tube in cases of severe vomiting. Food thus introduced is often retained when food taken in the ordinary way is immediately returned. A good mixture to employ in forced feeding of this description is 1½ pints of milk, two eggs, four ounces of milk sugar, and a little common salt. The caloric value of such a mixture may be reinforced by a protein preparation such as sanatogen, plasmon, etc. Such a mixture administered twice or thrice daily should be ample to maintain nutrition in a patient at rest in bed.

DIET IN FEVERS

CHAPTER X

DIET IN FEVERS AND ACUTE INFECTIOUS DISEASES

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General considerations.—The increased metabolism and consequent tissue waste involved in the febrile process makes the consideration of the diet in acute infectious disease a matter of great importance, of greater importance, indeed, than any method of treatment. Except in the case of diphtheria, for which we have a really scientific remedy in antitoxic serum, we cannot hope by drugs or otherwise to limit the course of the disease. We can only stand by and put the patient in the best possible condition for combating it. **The primary necessity,** then, is to **support the patient's strength,** which can only be done by a suitable system of feeding and stimulation. If the fever is prolonged, this may be a matter of considerable difficulty, as there is no doubt that the gastric digestion is often much impaired by continued pyrexia and toxæmia, and salivary digestion is liable to be reduced to a minimum, the saliva being often much diminished and occasionally assuming an acid reaction. Pancreatic digestion also suffers, and in a prolonged fever it is chiefly upon intestinal digestion that the patient depends. Mastication, again, cannot be counted on in patients who may be much exhausted and often delirious. There is always, moreover, in the early stages of an acute fever loss of appetite, and only too often disgust for food. Under these circumstances there is not much difficulty in concluding that the food given should be easily assimilable and, for the most part at least, fluid. The second great necessity in treating a case of fever is to **assist, so far as possible, the processes of elimi-**

nation. It must be remembered that the increased tissue waste must lead to an increase of the amount of urea in the blood which also contains, perhaps in large quantities, the toxins of the disease. The régime prescribed should favour, if possible, the elimination of these deleterious substances, and there is probably no better way than by supplying the patient with an adequate amount of fluid, preferably cold water.

When the patient reaches the convalescent stage, our object is to restore him as rapidly as possible to his full strength, and to repair the inevitable waste of tissue caused by the fever. A liberal diet is therefore in most cases indicated, although in certain diseases the amount of food allowed may have to be limited in view of the various complications which are liable to appear in this stage. In any case the transition from fluid to solid food must be made gradually, and the effect of each addition to the diet carefully watched.

Diet in the acute stage.—If a patient is to profit by his food, it is highly necessary that his desire for it be so far as possible stimulated, and that he be put in the best possible condition for appreciating it. In this connexion no point is of more importance than the **toilette of the mouth.** A fever patient, with dry baked tongue and sordes on lips and teeth, will enjoy his food far better if his mouth is carefully cleansed. Regular cleaning, moreover, helps to check the irregular fermentative processes which occur in the mouth, and which are liable to render the salivary secretion acid instead of alkaline. In severe cases, the mouth and tongue should be carefully cleaned every four hours with a soft piece of clean rag, and afterwards anointed with some mildly antiseptic ointment. A mixture of equal parts of glycerine and boro-glyceride is useful for this purpose, as is also the ointment which I am accustomed to use at the Edinburgh City Hospital, and which consists of one drachm of boracic acid to the ounce of vaseline, flavoured with five drops of peppermint oil. An adequate supply of fluid drinks, water for choice, does much also to keep the tongue moist and clean. The **serving of the food** is also of importance. The glass and crockery used should be scrupulously bright and clean. Neglect of this is quite sufficient to disgust a fastidious patient, and render him consequently much more difficult to feed.

The food should be given in **measured quantities at measured intervals,** and the amount given at one time should be small. The rule should rather be "little and often." An interval of two hours between the feeds is a convenient time, but this may be in some cases more prolonged, the amounts given being slightly larger. As a general rule, the feeding should be continued throughout the night, but it will usually be sufficient to wake the patient at four hour intervals. As a matter of fact, fever patients are often so restless and have their sleep so much broken, that a good nurse finds no difficulty in supplying them with sufficient nourishment without finding it necessary to wake them. If a feed has been missed, it is advisable not to increase the next one to such an extent that the loss is made up. It is extremely easy to overload the stomach, and as a rule, the patient stands the loss perfectly well. In special cases, where, for instance, a hypnotic has been given, or when sleep has been previously insufficient, it would be madness to wake the patient to feed him, unless his colour becomes very bad or his extremities cold. Sleep in such a case probably conserves his energy better than food.

In ordinary cases, where the fever is not unduly prolonged, there is little or no advantage in giving more than fluid food. In a prolonged fever like typhoid, or in the severe secondary fever of smallpox, this may have to be supplemented by soft solids, especially if the wasting is extreme, or if for any reason the patient enters upon the disease in an especially debilitated condition. But in diseases in which the febrile process is usually of short duration, as in measles or in lobar pneumonia, a fluid diet will be found perfectly adequate in the acute stage. **The most satisfactory form of fluid feeding** in the long run is unquestionably **a milk diet,** and in children particularly this need be seldom exceeded. Milk, containing as it does protein, fat and carbo-hydrates, at first sight would appear the ideal form in which to administer fluid food, but, as will be seen later, when the feeding of enteric fever is discussed, many theoretical objections to its exclusive use have been raised. Clinically, however, it is by far the best fluid food we can command and, if given properly, it is perfectly well digested by most patients. The safest way of giving it, and the precautions which its use demands, will be found in the section on enteric fever, the dieting of the acute stage of which may be taken as applying to all acute febrile conditions. The milk may, under certain circumstances, be supplemented by the various **meat broths,** beef, mutton, veal or chicken, and an occasional change in the basis of the broth given does much to vary the monotony of the diet. The food value of these additions to the diet is, no doubt, very small, but they are usually much appreciated by the patient. The different **extracts of meat** and **meat juices** may also be employed with advantage, if the use of the fresh juice of raw beef is not preferred. Another useful adjuvant to a milk diet is **albumin water.** This may be prepared by shaking up the beaten white of a fresh egg in about 8 oz. of water to which a little crushed ice has been added. The whole may be flavoured with lemon or orange juice or with a small amount of sherry or brandy. Its employment may possibly to some degree provide compensation for the great loss of nitrogenous substances. I seldom, however, employ it myself except in prolonged cases. In such cases, also, **protein preparations** of the class of somatose, sanatogen, or plasmon may be suitably added to the diet. Often a patient who dislikes one of these foods will quite readily tolerate another, and the medical attendant also may have his own preferences regarding them. I have always found Benger's food a most useful preparation, and employ it perhaps more frequently than any of the others named, though the cheapness of plasmon does much to commend it for hospital practice.

If, in spite of the addition of these various food substances to the milk, the patient appears inadequately nourished, **raw eggs** beaten up in milk and flavoured with brandy may be added to the dietary. Bread and milk, **arrowroot,** and other starch preparations, and **jellies** are also often admissible. As regards the latter, gelatine has a good reputation as compensating tissue waste. The jelly may be prepared from calves' feet or from commercial gelatine. It may be flavoured either with wine or with fruit juices.

As regards **drinks**, pure cold water is probably in the long run the most satisfactory, and should always stand at the patient's bedside. If he is unconscious or delirious, it must be forced upon him. Aerated waters are, of course, largely used, and without any enthusiasm for them, I must admit that a mildly alkaline water is probably often of advantage. They tend occasionally, however, to the production of too much wind, and in conditions where the digestion is upset they are better avoided. A little lemon or orange juice in large quantities of water sometimes assists in allaying thirst, and in any case is grateful to the patient. But it is a question if we should endeavour to allay thirst, as it is by ingesting large quantities of fluid that the patient facilitates the elimination of toxins and waste products. Tea may be allowed in moderation in most fevers, and is best given with plenty of milk. Cocoa is tolerated if the digestion remains fairly good, and a little strong coffee made with a very large proportion of milk is occasionally useful for patients who have a great dislike to milk given alone.

Diet in convalescence.—With the return of the temperature to normal the first solids may be given, if the prolonged nature of the illness has not made their previous use permissible. Sponge cake or sponge biscuit, given with a cup of tea or a glass of milk, is a useful first addition to a fluid diet. Milk puddings, fish soups, meat soups flavoured with vegetable juices and thickened with rice or oatmeal, finely minced raw meat sandwiches, oysters, well stewed fruit, and potatoes, well boiled and mashed with meat gravy or butter, are all suitable for the dietary of early convalescence. Thereafter fish, whiting for choice, sweetbreads, and in a few days white meat such as chicken. From chicken the patient may progress to a chop, after which his digestion may reasonably be regarded as capable of dealing with any ordinary diet.

The above suggestions indicate very briefly the diet which may usefully be employed in pyrexial conditions. Each disease, however, has its own peculiarities, and may from the nature of its pathology and complications demand special treatment. The dietary suitable for each is discussed in more detail in the following pages. As regards **stimulation,** the indications for its employment differ very considerably in the different fevers. Suffice it to say here that as a rule it is unnecessary in the acute infectious diseases, that children particularly are often better without it, but that in some conditions its use is indispensable.

DIET IN ENTERIC FEVER

It is universally admitted that in no acute infectious disease must more care be exercised with regard to the diet than in enteric fever. The conditions presented by this fever are such as to force upon the practitioner's attention various problems in connexion with the feeding of the patient. When we consider how extremely protracted the illness may be, and how enormous is the amount of tissue waste involved in the process, our tendency is to be liberal in our dietary with a view to maintain the strength of the patient and to shorten his convalescence. On the other hand, when we remember the state of the small intestine, often deeply ulcerated, always more or less impaired in its digestive power, we are rather inclined to cut down supplies of nourishment to the lowest possible amount, in the fear lest by giving too much we may but aggravate the condition. The result is that the dietaries which have been recommended for enteric fever vary from what might be fairly described as a full diet to what might, without injustice, be termed no diet at all. Between these extremes there is an extraordinary choice of dietetic systems, all of which are claimed as having given admirable results.

The results obtained by systems, very different in theory, but apparently equally successful in practice, almost lead us to the heretical conclusion that diet, after all, is not a matter of such supreme importance in enteric fever. Patients often do admirably with large quantities of solid food. Others do equally well on a diet from which all solids are excluded, or which may be even limited to small quantities of water alone for days at a time. If any deduction is to be made from this it is, I think, that the condition of the food when it reaches the small intestine is a matter of much more importance than its condition when it is offered to the patient. The residuum left by milk may be, and often is, far more irritating to the intestine than the residuum of a mutton chop. Another point worth considering in this connexion is that in many cases of enteric fever the bowel is very slightly affected. In many cases, fatal from toxæmia, the intestinal lesions are most insignificant, and occasionally are wanting altogether. Probably, a considerable proportion of the patients who recover have but little ulceration, and of them it would be certainly fair to conclude that they would get through the fever whether their diet was solid or fluid.

The most reasonable course to take in prescribing a diet for an enteric patient is, I think, to treat him as a patient and not as a case, and to modify the dietary according to his personal idiosyncrasies and the character of his illness. On the other hand, it is highly desirable to have some definite line of treatment, and the diet must necessarily be such as not to interfere in any way with the theory on which that treatment is based. It is my intention in this article first to describe a dietary which may be used with advantage whether the patient is treated expectantly, with antiseptics, or with cold baths; secondly, to discuss the modifications which may be called for in the presence of certain complications; and lastly, to give some account of special dietaries which have been suggested by various writers, and which seem to me to be worthy of notice. The practitioner, however, whose experience of treating this fever is limited, will do well to rely, at first at any rate, on a dietary more or less on the lines indicated below.

Diet for ordinary cases in the acute stage.—The value of milk as a food in any fever is, of course, beyond all question, and it is still recognized by most authorities as the most suitable form of diet for cases of enteric fever. Still, if the greatest care is not taken, there are few foods which are capable of doing more harm. The famous epitaph of Graves has, perhaps, been responsible for a tendency to overfeed fever patients. Overfeeding, if the staple article of diet is milk, may be very dangerous, as if more is ingested than the patient's alimentary system can adequately deal with, large masses of undigested curd are left to irritate the ileum and the lower bowel. The result is meteorism or diarrhœa, which are always dangerous and too often fatal. On the other hand, it is not enough to merely limit the amount of milk which is to be given in the twenty-four hours. Even moderate and reasonable quantities, given improperly, may cause much mischief. The most common error, one far too frequently met with, is to allow the milk to stand at the patient's bedside. As a result, it is used to quench his thirst, and small amounts are taken at very short intervals. Undigested milk is mixed with partially digested and completely digested milk in the stomach, and the whole mass may be passed on into the duodenum very imperfectly treated by the gastric juices. The consequence is that the stomach gets no rest, and the intestine is asked to deal with masses of curd. Under such circumstances it is quite impossible to expect good results.

Rules for the administration of milk.—Milk, however, still remains, in my opinion, far the best staple food for the enteric patient, and all that is necessary to render its employment perfectly safe is to lay down sufficiently rigid rules for its administration. The first of these is that on no account is it to be used to quench the patient's thirst. Rather is it to be regarded as the solid part of his food, water being supplied freely when he requires it. Secondly, the milk should be supplied in measured quantities and at regular intervals. Each supply should be looked upon as a definite meal. As regards the length of the interval between these meals I am accustomed to make it two hours. In many cases, no doubt, a large amount of milk every three hours would be equally satisfactory, and at night it will be often found advisable to prolong the intervals so as to disturb the patient's sleep as little as possible. It would be imprudent, however, to leave the patient without nourishment for more than four hours, even at night. As regards the amount of milk given, I am convinced that the power of milk digestion in the average patient is much overrated. I never start a case on more than 3 oz. every two hours, that is to say, somewhat under two pints daily. It is seldom of advantage to increase this amount beyond 4 or 4½ ozs, two hourly. Personally, I make 4 oz. my maximum amount, and do not often exceed 3½. Larger quantities are often very imperfectly digested.

The milk is always the better for being diluted, and for this purpose hot water may be added in the proportion of 1 to 4, or 1 to 3, of milk. The warmth of the mixture assists the digestion, which is also aided by the dilution, the curd being probably less firm. If more drastic methods of moving the bowels are objected to, fluid magnesia may be added to the water used as the diluent. Limewater is also very useful in this connexion, should there be a tendency to diarrhœa.

Another rule of great importance is that the portion of milk must be consumed within a reasonable limit of time, certainly within a quarter of an hour. On no account is it to be allowed to stand at the bedside. It is very necessary that the stomach should have an adequate rest before the next meal.

As long as milk is given as the staple article of diet, it is highly desirable for the stools to be carefully examined daily. The presence of undigested curd, whether in large masses or small flakes, proves that either more milk is being given than the digestion can tolerate, or that proper care is not being exercised in its administration. The deduction of half an ounce from the two hourly allowance is often sufficient to cause a complete disappearance of curds from the motions, and as a result to check that looseness of the bowels so often occasioned by the presence of undigested food in the intestine. If it is found that milk is badly tolerated by the patient, even when given carefully, an admirable substitute may be found in whey.

Supplements to an exclusive milk diet.—While many patients are quite sufficiently nourished by milk alone, it is advisable to supplement such a diet by the use of beef tea, meat extracts, and similar preparations. As regards the first, it is well to wait till the patient has been twenty-four hours under observation. Should diarrhœa be present, the use of hot beef-tea would only aggravate it; should there be blood in the stools, anything tending to loosen the bowels is to be deprecated. On the other hand, if after a short period of observation it is found that the patient is not suffering from diarrhœa and that the condition of the stools is satisfactory, the use of one or other of the meat broths is of distinct advantage. A purely milk diet is terribly monotonous, and a reasonable allowance of chicken or beef-tea is much appreciated by the patient, even though its food value may be very small. These preparations should be given well salted. They form, indeed, an admirable vehicle for the salt which is so much craved for by patients who are kept upon an exclusive milk diet. Much of the hunger, in fact, which is so characteristic of enteric fever is probably due to the deprivation of salt which a strict milk régime entails. The first articles of food desired are usually those which have a salt flavour, such as ham, kippered herrings, and the like. And this "false appetite" often disappears completely if a sufficiency of salt is added to the chicken or beef tea. I prefer this to salting the patient's milk which, however, may be done in moderation if it is considered undesirable to use the meat preparations. Taste is often so blunted in enteric fever that an amount of salt, which would be nauseous to an individual in health, is readily tolerated. Still, it is necessary to take the greatest care not to disgust the patient with milk if he is to depend on it as his chief article of diet.

Value of beef-tea, etc.—It has been said above that the actual food value of beef or chicken tea is probably extremely small. They are much more useful as stimulants and hypnotics. Professor Wyllie, to whose teaching and example I owe this particular system of dieting, was accustomed when at the Edinburgh City Hospital to recommend that the daily allowance of beef-tea, usually a pint, should be divided into three equal portions, the first of which, given at midday, broke the monotony of the constantly repeated milk, the second, given very hot at night, assisted the patient to get to sleep, and the third, given in the early hours of the morning as a stimulant, helped to tide the patient over the period of his greatest depression. I am certainly convinced that by a rational use of hot chicken or beef-tea in this manner, hypnotics and alcoholic stimulants can be often dispensed with. The distinct laxative effect of beef-tea, moreover, is occasionally very useful.

In cases of diarrhœa it may be found advantageous to make use of the many meat extracts which are nowadays available, or to employ raw meat juice. As a rule, the former preparations are the most convenient. They should be given cold and mixed with a little water. I usually prescribe bovinine, in the nutritive value of which I have a very firm belief. Valentine's meat juice is also admirably tolerated by patients with severe diarrhœa, and a very pleasant and sustaining preparation is Brand's chicken jelly, which is the most agreeable of the three from the point of view of the average patient. There is a wide choice of meat extracts, and the practitioner will do well to employ the one in which he has reason to feel most confidence, always provided, of course, he is satisfied that it will not aggravate the diarrhœa.

Through the whole of the acute stage much may be gained by the careful inspection daily of the patient's mouth and tongue. The **toilette of the mouth** is most important and if, when this is carefully attended to, the tongue still remains very dry, the suspicion should be aroused that fluids are not being given in sufficient amount.

Additions to the above diet in prolonged cases.—While in my experience the average enteric patient maintains his strength satisfactorily on the limited diet outlined above, in certain cases it will be found advisable to supplement it. When the fever is very prolonged and there is excessive wasting, such substances as plasmon, somatose, sanatogen and similar preparations may be added. Half an egg beaten up in a little milk with a teaspoonful or two of brandy can be given twice in the twenty-four hours. Albumin water may also be found useful. A small amount of very well boiled rice may be added to the beef or chicken tea allowed to the patient. Jelly with various fruit or wine flavourings may also be safely employed to supplement the diet. This greater liberality is also advisable in cases of relapse, especially if the first attack has been at all prolonged. Wasting is, of course, to be expected in every case of enteric fever but it may unquestionably be allowed to go too far. Any of the above additions to the dietary may also be made in cases where the hunger of the patient appears to remain unaffected by an increase in the amount of milk given, or by the addition of more salt to the food allowed. This is particularly the case during the stage of defervescence.

Indications for increasing the diet in convalescence.—Assuming a patient has satisfactorily passed through his fever, and his temperature is approaching the normal line, when is the first increase of diet to be made? Much must depend upon the circumstances of the individual case. Unless he is really hungry, there is no particular advantage in making any addition to the diet till the temperature is steadily normal. By "real hunger" is to be understood a genuine craving for food; that is to say, it is not enough for the patient to reply that he is hungry when asked. He must volunteer the information himself. If his hunger is real and all precautions to satisfy a false appetite have already been taken, some addition to his food may be allowed when his temperature is normal in the mornings, the evening readings being disregarded. Should his diet, up to this point, have consisted exclusively of milk and meat broths, with the few extras that may have been permitted in prolonged cases, it is obvious that, before he is allowed solid food, he must be content with semi-solids and "sloppy" materials. Benger's food or boiled bread and milk are usually my first additions, and the effect of even this slight increase of diet on the temperature of the patient should be carefully noted. If the morning temperature remains normal, the bread and milk is continued for two or three days, the amount given being gradually increased and a little well-made oatflour porridge being added to give variety. By this time the evening temperature has also frequently settled, but even if not another increase may be safely tried, always provided there has been no rise above normal in the mornings. At this stage the first solids may be given, a sponge biscuit or a small amount of light sponge cake being a quite suitable substance to experiment with. If this is tolerated, I am accustomed next day to allow a very small quantity of white fish. This should be boiled or steamed, and all skin should be carefully removed. The best fish for this purpose is whiting, but in hospital practice fresh haddock forms an admirable substitute. A very thin finger of bread, from which all crust has been cut, may be given with the fish. On the following day, always assuming the morning temperature remains steadily normal, a little thin bread and butter may be allowed at breakfast and tea time, the patient still receiving a reasonable quantity of milk at definite intervals, and beef or chicken tea being continued exactly as before. For three or four days this diet may be continued, the amount of food given being cautiously increased, and such additions as a little baked custard pudding or some well boiled milk-pudding may be permitted. Should the morning temperature rise above normal, it is wisest to go back to the fluid diet at once, until at least the cause of the pyrexia has been ascertained. It is quite possible, of course, that the cause may lie elsewhere than in the diet. Constipation, for instance, is often troublesome at this stage, and the temperature of the enteric convalescent, being extremely mobile, is very readily affected by it. Such complications, moreover, as phlebitis, otitis media, and superficial skin abscesses may supervene in convalescence and cause some degree of fever. In such instances it is rarely necessary to make much modification in the diet and, the pyrexia being satisfactorily accounted for, the appetite of the patient may be taken as a rough guide for the amount of food required.

Should, however, the addition of solids to the dietary leave the temperature quite unaffected, after a few days of steady increase in the amount of food given, a further step may be taken and the patient allowed a little of the breast or wing of a chicken. My patients, as a rule, receive this from three to five days after their first allowance of fish. With the chicken may be given a little mashed potato, which, indeed, I frequently allow to be added when the diet is still limited to fish. Chicken having been allowed, except for the addition of stewed fruit, the diet is kept well in hand till all chances of relapse are over, after which (say after a fortnight's normal temperature) there is no reason why meat should not be allowed in moderation. In moderation, indeed, success in the dieting of an enteric patient usually lies. As much variety of food as possible should be given, but at first only in small amounts.

The temperature in convalescence and relapses.—It will be noticed that very little attention is paid to the evening temperature. As a matter of fact it cannot be regarded as a reliable guide. A temperature which is normal in the morning and swings up one or two degrees at night sometimes depends upon inanition. It is a "starvation temperature" and the longer one waits for it to settle the less likely is it to do so. Extra feeding often brings it down to normal in a couple of nights. A point of more importance to notice is whether the temperature is subnormal rather than normal. A case in which the temperature is steadily subnormal after the completion of the lysis seldom relapses. If, on the other hand, it runs along the normal line, as it is usually marked on clinical charts, there is a considerable chance of relapse. In the latter circumstance it is wiser to be moderate with the feeding and to advance the patient less rapidly, restricting him rather to the stage of fish and light farinaceous foods.

As to the **effect of diet on the occurrence of relapses** it is, I think, very problematical. An injudicious addition to the diet may cause a rise of temperature most undoubtedly, but such a rise will subside on the removal of the cause. In some patients, especially in those who have been very rigidly dieted, the first addition of solid food occasionally causes some elevation of temperature, possibly from a reflex cause. To others again the first allowance of solids is such an event that their excitement is quite sufficient to account for the subsequent pyrexia. But these rises of temperature are not repetitions of the original fever. In other words, they are not relapses. They are due merely to local irritation or to nervous excitement as the case may be. They are also often due to constipation. The fact that, in cases which relapse, the spleen remains markedly enlarged during the apyrexial interval would point to the cause of relapses being connected with that organ, and it may be added that relapses occur at least as frequently in those cases which are dieted rigidly as in those which are fed liberally. This is shown by the fact that the percentage of relapses in a series of 397 consecutive cases of enteric fever, who were fed less liberally and less early in convalescence than is suggested above was 5·79, whereas out of a subsequent series of 758 cases, whose diet was on the exact lines I have indicated, only 3·95 per cent relapsed. Both series were treated by myself in the Edinburgh City Hospital. The fact that the general treatment differed considerably is of little importance. The figures go far to show that relapses are at least not increased by early and liberal feeding in convalescence, as do also those published by Kinnicutt, which are quoted later in this article.

Drink of the patient during the fever.—In the acute stage of the fever we have seen that the patient is restricted to a fluid diet. But it was emphasized that the milk is to be regarded as the solid part of the patient's food and must be given in regular meals. It cannot, then, be used to quench the patient's thirst. For the latter purpose there is nothing more suitable than cold water, which must always be kept standing at the bedside so that the invalid can help himself. The greatest attention must be paid by the nurse to unconscious and delirious patients, and water should be offered them frequently and forced upon them when necessary. Much good, in fact, can be done by forcing large quantities of water upon patients. All will probably agree that 3 or 4 pints a day should be a minimum allowance.[1] As regards greater amounts than this the reader is referred to the discussion on a subsequent page of the subject of systematic treatment by the ingestion of large quantities of cold water.

We are accustomed to see large quantities of **aerated waters** given in the various fevers, usually in conjunction with milk. In enteric fever I cannot but think that they are a most undesirable addition to the liquids allowed. They are most liable to cause more or less distension, and there are few conditions likely to do so much harm in the course of enteric fever. Meteorism, indeed, is one of the complications which, when it occurs, calls for some modification of the diet, and it seems reasonable to prevent its occurrence, as far as possible, by avoiding anything which may cause accumulation of gas in the intestines. It may be admitted that the average British patient, unlike his American cousin, seems to have the most rooted objection to drinking plain cold water, unless, of course, he suffers from intense thirst. To induce him to drink more a lemon acid drink may be prescribed, composed of a few drops of dilute hydrochloric acid and syrup of lemons very freely diluted, but retaining

[1] The 3 or 4 pints of water recommended are in addition to the fluid diet already prescribed.

a sufficient taste of acid to be refreshing to the patient. It is always easier to induce a patient to drink something which has a definite flavour, and moreover hydrochloric acid has a certain classical reputation in the therapeutics of fever, and has been recommended as a mild febrifuge both by Murchison and Fagge.

Under ordinary circumstances it is only reasonable to allow **tea** to those patients who appreciate it. A cup of tea given to a female patient at about 4 o'clock in the afternoon is usually rather good for her than otherwise. It is an event in the dreary monotony of the day and has, as a rule, a good effect mentally. It is needless to say it should be freshly infused, not too strong, and given with plenty of milk. The only contra-indication is marked insomnia, although it is very doubtful if tea exercises much effect in keeping awake those who are thoroughly accustomed to it.

Alcohol in enteric fever.—It is entirely a mistake to suppose that enteric fever patients need alcohol necessarily as a routine. On the contrary, it is certain that much harm may be caused by its indiscriminate use. The too liberal employment of stimulants in this fever is associated in my mind with such conditions as restlessness of the patient, irritability of the bowels, and increased liability to hæmorrhage, and other ulcerative accidents. The vast majority of patients are able to dispense entirely with alcoholic stimulants throughout the whole course of their fever. Of my own patients not more than one in ten is systematically dosed with alcohol. A slightly larger number get occasional doses should necessity arise.

As regards the indications for stimulation, patients who are alcoholic will probably require it. Elderly patients, again, persons over forty years of age, are much more likely to benefit by the use of alcohol than children or young adults. When the pulse becomes rapid, exceeding 120 in an adult, when the first sound of the heart is almost or quite inaudible at the base, and when the tongue is severe and very dry, the advisability of prescribing stimulants must be seriously considered. In cases, also, where there is marked pulmonary congestion alcohol is often of great advantage. Even in these circumstances, however, its systematic and regular use may not be necessary and often very small amounts once or twice repeated may have the effect desired. In every case the result of the dose of alcohol must be carefully noted, and if it does not favourably affect the rate and character of the pulse there is little use in persisting with it. If, again, the patient becomes restless and excited, it is probably doing him more harm than good. It is always well to remember Jenner's advice on this subject. If in any doubt about stimulating, don't!

Stimulants may be found useful in small quantities on certain special occasions. If the cold bath treatment is being systematically used a small dose is prescribed by most authorities immediately after the patient is removed from the bath. Again, after irrigation of the large intestine, a prolonged and somewhat exhausting operation, it may be occasionally advisable to give a small quantity of spirits. Under certain circumstances, again, a little whisky in the form of hot toddy may be found useful as a soporific if a cupful of hot beef-tea has failed, and if a hypnotic drug is not thought necessary.

As regards the choice of the stimulant employed, during the acute stage there is probably nothing more useful than sound Scotch whisky. This may be started in doses of even such small amounts as one drachm every four hours, and should rarely be increased beyond half an ounce at similar intervals. If there is much diarrhœa, or any tendency to sickness, brandy is more useful and is likely to be better tolerated. In convalescence many patients are much the better of a glass of port wine with their dinner and at night, and in private practice a good Burgundy may be employed at this time with great advantage.

Modifications of diet to meet various conditions.—In a case in which care has been taken with the dieting it is unusual for troublesome **diarrhœa** to occur. On the contrary, this symptom usually subsides when the patient is fed suitably. Occasionally severe diarrhœa may persist, or may indeed even supervene in a properly treated case. If the patient is having beef or chicken tea these should be at once stopped. If any substitute for these is desired, raw meat juice or one of the patent meat extracts may be given. The milk should be boiled and diluted with lime water instead of with water alone. If this is insufficient to check the condition the amount of milk should be considerably reduced, and it may be peptonized or pancreatized. If whisky is being given it should be withdrawn and brandy substituted. Again, in cases of **meteorism** much may be done by reducing the amount of milk and by peptonizing it if necessary. The desirability of avoiding aerated waters has been already alluded to. When **constipation** is troublesome the addition of beef-tea, if it is not already being used, will often have the required laxative effect. If the patient is already supplied with it the quantity given may be considerably increased, or it may be made stronger. A little fluid magnesia may also be added to the milk. If **hæmorrhage** should occur an absolute starvation is indicated for the first twenty-four or thirty-six hours, the object being to entirely rest the intestine and to avoid encouraging peristalsis. Neither milk nor water should be allowed even in the smallest quantities. The apparent cruelty of this proceeding is much diminished by the fact that in such cases morphia or opium is usually given freely, also with the object of checking peristalsis. The patient, then, is too much under the influence of the opiate to notice the withdrawal of his food and water. After twenty-four or thirty-six hours, according to the strength of the patient and the occurrence, or not, of further hæmorrhage, I usually order a half teaspoonful of bovinine in two or three drachms of iced water as the first food, and this may be repeated every two or four hours. Twelve or twenty-four hours later peptonized milk may be added, given in teaspoonful doses at first, and given every hour if the patient is awake. The amount of milk may be rapidly increased if the bleeding does not recur, the patient usually receiving one ounce every two hours within seventy-two hours of his hæmorrhage, in addition to meat juice or chicken jelly. If this is well borne, double that amount may be given on the following day. It is almost unnecessary to add that if the patient has been previously on some alcoholic stimulant this must be withheld, unless the hæmorrhage has been so profuse as to render him practically pulseless, in which case it will be necessary to administer brandy very cautiously in half teaspoonful doses at frequent intervals, taking the greatest care not to improve the pulse too much or too suddenly.

If **perforation** has occurred it is obvious that recovery can hardly be considered as possible unless an operation is performed, so the question of diet is of little practical importance. It is advisable, however, to cease feeding by the mouth for the few hours which elapse before the perforation is surgically dealt with. On the other hand free stimulation may be necessary, and brandy must be given by the mouth or rectum as circumstances dictate. After the operation the nourishment should be very cautiously administered, as it is exceedingly important to prevent the occurrence of vomiting. Small quantities, say half an ounce, of iced peptonized milk, may be given hourly, and raw meat juice or chicken jelly will be found useful. Rectal feeding may be preferred and in any case small saline injections of from 6–10 oz. are often of great service. If the case is regarded as inoperable very similar treatment to that of hæmorrhage is necessary, as it is only by checking peristalsis and keeping the intestine empty that that exceedingly rare result, the natural cure of a perforation, may be brought about.

Of other conditions likely to complicate the course of an enteric fever **persistent vomiting** may require a modification of the diet. In this case peptonizing the milk may be first tried. If that fails iced albumin water may be given. Raw meat juice is sometimes taken well when milk is not tolerated by the stomach. As a last resort rectal feeding may be necessary. In convalescence such conditions as **phlebitis**, **periostitis**, or **skin abscesses** call rather for an increase than a diminution of the diet, always provided the pyrexia is not so decided as to interfere much with the gastric digestion.

General considerations.—The above lines of dieting have answered very well in my experience, and they are recommended especially to those who, having only a limited experience of enteric fever, are anxious to adopt a perfectly safe method. Like all other systems, this one demands considerable supervision on the part of the medical man, and much care and attention on the part of the nurse. It is well to remember that the more strictly a patient is dieted the more he is liable to suffer from any sudden irregularity in his diet. The physician should inspect the stools frequently, to see whether the milk has been well digested and any appearance of curds, after the first few days of treatment, should arouse the suspicion that the milk may have been given improperly. The abdomen, also, should be inspected and palpated daily. Any increase of tumidity or tenseness suggests either imperfect digestion or some want of care in the feeding. The first can be usually remedied by modifying the diet.

As has already been stated, other methods of dieting, chiefly on more liberal lines, have been strongly advocated, and the success which they have met with at the hands of competent physicians has been such as to demand our most earnest attention. It has been thought well, therefore, to mention some of the more important. Their study is instructive as, when dealing with patients who cannot tolerate milk, we are often perplexed to know what may be safely substituted for it.

Diet for children.—It is obvious that except in the youngest children the diet, as recommended for adults, can in most cases be given. Any modification of it should be in the direction of caution rather than liberality. Children as a rule tolerate milk and thrive on milk much better than adults, and a milk diet in the acute stage, gradually increased to soft solids in convalescence and solids a little later than is recommended for adults, will in most instances be found quite satisfactory. Stimulants are better avoided, especially in the case of younger children.

The diets suggested on p. 323 may of course be much modified. They are merely included to express graphically the progress of a case. The amounts of milk given must of course depend on the patient's inclination for food and his toleration of milk. Thus 4 oz. may be given in a prolonged case with much wasting, provided it is well digested. If porridge is not liked, bread and milk may take its place, or the patient may prefer Benger's food, or a beaten-up egg in milk at the corresponding times of the day. The changes may be rung with these foods for patients whose appetites are capricious. A few methods for preparing such foods are appended.

Oat flour porridge, or gruel.—Soak the oat flour in a little cold water for at least two hours. Then strain through a fine

SUGGESTED DIET FOR ADULTS.

	Acute Stage.	Prolonged Case or Relapse.	Early Convalescence (first few days of normal temperature).	Convalescence.
4 a.m.	Hot beef or chicken tea, 7 oz.; milk, 3 oz.	Beef-tea, 10 oz.	Beef-tea, 10 oz.	
6 a.m.	Milk, 3 oz., diluted.	Milk with plasmon.	Oat flour porridge with milk.	Oat flour porridge, milk.
8 a.m.	Milk, 3 oz., diluted.	Milk, 3 oz., with half a switched egg.	Tea, thin bread and butter.	Tea, eggs, bread and butter.
10 a.m.	Milk, 3 oz., diluted.	Milk, 3 oz., diluted.	Milk, 6 oz. to 10 oz.	Milk (if hungry).
12 noon.	Hot beef or chicken tea, 7 oz.; milk, 3 oz.	Hot beef-tea, 10 oz.; wine jelly; milk, 3 oz.	Beef-tea thickened with rice, fish, milk pudding, jelly.	Soup, fish or chicken, milk pudding with stewed fruit, jelly with cream.
2 p.m.	Milk, 3 oz., diluted.	Milk, 3 oz.	—	—
4 p.m.	Milk, 3 oz., diluted, and a cup of weak tea.	Milk, 3 oz.; tea.	Tea, thin bread and butter, jelly, such as apple jelly.	Tea, a boiled egg, bread, butter and jam.
6 p.m.	Milk, 3 oz., diluted.	Milk, 3 oz., with half a switched egg.	Milk, 6 oz. to 10 oz.	—
8 p.m.	Milk, 3 oz., diluted.	Milk with plasmon.	Oat flour porridge with milk.	Oat flour porridge with milk, bread and butter.
10 p.m.	Hot beef or chicken tea, 7 oz.; milk, 3 oz.	Hot beef or chicken tea, 10 oz.; milk, 3 oz.	Beef-tea (if awake, or later).	Hot beef-tea (if awake in the night).
12 night	Milk, 3 oz. (if awake, if not, at 2 a.m.).	Milk, (if awake, if not, at 2 a.m.).	Milk (if awake).	

sieve. Bring some cold water to the boil and add a liberal allowance of salt, making the water more salt than a person in health would find agreeable. Stir in the strained oat flour and stir steadily till the mixture again boils. Then keep it at the boil for half an hour, stirring at intervals. A small teacupful of this porridge with milk added to fill a breakfast cup is a reasonable allowance for an adult patient to start with.

Plasmon.—Put a dessertspoonful into a cup with a little lukewarm water and stir into a cream. To make a small teacupful put a little milk in a saucepan. Bring it to the boil. Stir in the plasmon. Boil again. Have the white of an egg ready switched. Stir it in and add sugar to taste.

Bread and milk.—Grate bread crumbs very finely. Bring milk to the boil. Stir in the crumbs slowly, letting them fall constantly from the hand. Let it boil twenty minutes. Add if desired some switched egg or the switched white of an egg. Add sugar to taste.

Liberal feeding in enteric fever.—There is no doubt that theoretically much is to be gained by giving a liberal and varied diet. When we consider the extreme wasting which often occurs, even when the patient is taking freely all the fluid nourishment which we are accustomed to consider desirable for him, the reflection is forced upon us that the heart and intestinal walls may be suffering almost equally with the muscles. The bowel wall of a patient who has succumbed to a prolonged fever is often found at the autopsy to be extremely thin. Is it possible that by restricting unduly the food supply of the patient we are weakening the resistance of his bowel wall to the ulcerative process ? I am convinced that the use of solid food early in convalescence does much to shorten the duration of the case. Does the more liberal supply of food at this period help to promote the healing process in the ulcerated intestine as well as to repair the waste caused by the fever ? That it prevents to some extent such sequelæ as periostitis, abscesses, and otitis media is certainly probable. If such additions are justifiable from the moment the patient's temperature touches the normal line, would they not be equally so at an earlier period, say at the commencement of the lysis when he is beginning to show signs of returning appetite ?

The only argument against giving solid food throughout the fever, say the advocates of a mixed diet, is the inability of the patient to take it. Other objections are mainly theoretical, such as that it is liable to cause such accidents as perforation and hæmorrhage, or that it increases the tendency to relapse. We have seen above that early solid feeding in convalescence has little or no influence on the frequency of relapses. There is therefore no reason to believe that relapses should be more frequent in cases which have been fed on a mixed diet during the acute stage. It is possible, however, that such a treatment might prolong the original fever, but this, according to the supporters of solid diet, is not the case.

Theoretical objections to milk.—On the other hand, although most physicians will agree that milk is the most convenient food to use during the acute stage of enteric fever, it is not altogether an ideal diet. The patient who is fed exclusively upon it gets more fat than is necessary and probably too little protein. The carbo-hydrates are certainly insufficient from the theoretical point of view. It is said, and no doubt so far as laboratory experiments go the statement is correct, that to make good the waste caused by the increased metabolism in such a fever as enteric it is necessary for the patient to take 8 oz. of milk every two hours. Such an amount it is obviously impossible to give, and if, therefore, the waste is to be considered the milk must be supplemented by other articles of food.

It has also been suggested that, as milk is extremely deficient in iron salts, the prolonged anæmia which often follows enteric fever may be in part due to the fact that a milk diet is used. Digestion, moreover, is rendered more easy by the reflexes excited by the mastication of solid food in the mouth, and on the other hand suffers when the food given excites disgust, as the long-continued monotony of a milk diet is apt to do. Milk, again, becomes a semi-solid in the stomach and therefore cannot properly be considered as a fluid food. The curds are not always easily broken up and digested in the small intestine. We have seen that this difficulty can, as a rule, be obviated by proper care being taken in its administration, but at the same time we must admit that the undigested residuum of milk is often most irritating to the bowel. Again, it has been asserted that milk acts as an admirable culture medium for the typhoid and intestinal germs, and that its employment should be limited on that account. This objection is probably slightly more valid than the identical one which has been raised with regard to the use of beef-tea, which can leave practically no residuum for the benefit of the intestinal bacteria.

The acute stage: suggestions for dieting with solid food.—No account of the dietetics of enteric fever can be considered adequate without some reference to the interesting dietary suggested by the Russian physician, Bushuyev. His published results did much to stimulate experiments in the direction of a more liberal diet, especially in America, and if few have followed his plan in its completeness many have modified it and have been satisfied with the results obtained. Bushuyev's treatment is to give solid food to all who can take it from the moment they come under observation. Meat, bread, and boiled eggs are all allowed. The number of patients treated was 398, and only four of them suffered from hæmorrhage and one from perforation. It would appear, therefore, that the ulcerative complications of the fever were very much less frequent than is ordinarily the case, and even allowing that the type of the disease may have been less severe than usual, it is fair to conclude that solid feeding does not predispose to these dangerous conditions. No figures relating to the occurrence of relapses are given by Bushuyev, which is unfortunate, as it is particularly alleged against solid feeding that it renders relapses more common. The mortality of the cases was 8·2 per cent. The Russian physician is convinced that, once the patient's interest can be stimulated in his diet, his general condition is rapidly improved. Even patients, extremely ill, with temperatures exceeding 102° F., sit up in bed and are able to feed themselves, only few requiring the help of the nurses. Every effort must be made to stimulate the appetite and to avoid disgusting the patient with his food.

The following is the dietary suggested by Bushuyev for the acute stage :—

7 a.m.	Tea with a roll.
8 a.m.	Oatmeal, barley, or wheat liquid porridge with butter (about 13 fluid oz.).
9 a.m.	One or two boiled eggs, hard or soft, as the patient prefers.
10–11 a.m. . . .	A glass (about 7 oz.) of milk, a roll, half a cutlet and a piece of boiled meat.
12–12.30 p.m. . .	A plate (7 oz.) of chicken soup, or ordinary soup, and a cupful of jelly.
3 p.m.	Tea with a roll.
6 p.m.	A cup of chicken or beef-tea, semolina pudding or milk, a bit of chicken.
8 p.m.	Milk with a roll.
During the night .	Coffee or tea with milk two or four times, coffee with cognac.

In addition to the above the patients receive from 1–3 oz. of wine in the morning and half an ounce of Stoke's mixture of egg and brandy every two hours. The diet altogether seems excessive, but it is interesting to know that it can be given without harming the patient. To most of us it would appear adequate to nourish a healthy man in full exercise.

In England Barrs, whose results were published a year earlier than those of the Russian physician, while believing equally in the value of solid food, takes a less pronounced and more rational view of the question. He does not recommend that the patient's appetite should be forced. "To give a patient with dry and shrivelled tongue, teeth covered with sordes, semi-comatose from pyrexia, and utterly indifferent to all around him, and especially to food, meat, or any other solid would be to my mind as silly and as cruel as to withhold it from a patient who expresses himself as genuinely hungry and who looks so, because his temperature curve is not normal, or because his bowels are acting a little too frequently." The appetite of the patient, once the physician has satisfied himself that the hunger is really genuine, is to be regarded as the indication for solid food. Barrs considers, from a study of his cases, that there is no reason to believe that diarrhœa is rendered worse by a liberal diet, or that perforation occurs more frequently in liberally fed patients. Meteorism, again, is less likely, he thinks, to occur on a diet which contains a reasonable quantity of solids than on one exclusively fluid. Meat and bread are allowed throughout the acute stage. The meat is usually minced at first, as otherwise it is difficult to take, unless the patient is allowed to sit up, which it is certainly most dangerous, notwithstanding the views expressed by Bushuyev, to allow any enteric patient at the height of his fever to do.

The acute stage: soft solids and mixed diet.—Shattuck in the Massachusett's General Hospital feeds his enteric fever patients on the following lines.

1. Milk, hot or cold, with or without salt, diluted with lime water, soda water, Apollinaris, or Vichy; peptogenic and peptonized milk; cream and water; milk with white of egg, buttermilk, koumyss, matzöon, milk whey, milk with tea, coffee and cocoa.

2. Soups: beef, veal, chicken, tomato, potato, oyster, mutton, pea, bean, squash; carefully strained and thickened with rice (powdered), arrowroot, flour, milk or cream, egg, barley.

3. Horlick's food, Mellin's food, malted milk, carnipeptone, bovinine, somatose.

4. Beef juice.

5. Gruels: strained corn meal, crackers, flour; barley water, toast water, albumin water with lemon juice.

6. Ice cream.

7. Eggs, soft boiled or raw, egg-nog.

8. Finely minced lean meat, scraped beef. The soft part of raw oysters. Soft crackers with milk or broth. Soft puddings without raisins. Soft toast without crust. Blancmange, wine jelly, apple sauce and macaroni.

This diet may be accepted as that favoured by American physicians who believe in varied feeding. Manges, Fitz, and Kinnicut, from whose admirable paper on the "Principles of Feeding in Typhoid Fever" I have abstracted it, have all had success with a diet very much on the above lines. Vaquez in France has also had good results with a diet consisting of milk, soups thickened with oat or rice flour, meat jelly, the yolks of three eggs daily, and somatose during the period of advance, and during the lysis grated meat, mutton for preference, instead of the meat jelly. Marsden at the Manchester Fever Hospital allowed bread and milk, custard, and minced meat to those patients who were hungry, and added fish in very many instances before the temperature reached the normal. His relapses numbered 13 per cent and had apparently no connexion with additions to the diet. The hæmorrhage rate was low, only 3 per cent, and among the 200 cases there was no instance of perforation.

Marsden's conclusion is that on such a diet there is more rapid recovery, less risk of surreptitious feeding with undesirable substances, and a lessened tendency to asthenic complications.

My own experience of liberal feeding throughout the fever is a somewhat limited one, but I must confess that I saw no harm result from the use during the acute stage of milk puddings, bread and milk, and beef-tea thickened with well-boiled rice, the diet which was given by my predecessor at the Edinburgh City Hospital at the time I worked there as house physician. At present, however, as I have already stated in the earlier part of this article, I prefer to postpone semi-solids and solids to the period of early convalescence. The interesting figures, however, published by Kinnicutt go far to prove that it is quite safe to give a liberal dietary. He has collected records of 4,654 cases treated with fluid and of 733 with liberal diet, and the results are as follows:—

	Cases.	Relapses per cent.	Hæmorrhages per cent.	Perforations per cent.	Mortality per cent.
On liberal diet . . .	733	11·38	4·77	1·36	9·47
On fluid diet	4,654	10·89	8·83	2·40	10·55

It is of course difficult to draw conclusions from statistics of this sort, but the greatest care has been taken by Kinnicutt to secure that the test should be a fair one. The most interesting feature is the larger number of ulcerative accidents in the second group. It may fairly be asked does a low diet by starving the bowel walls help to increase rather than limit the process of ulceration?

Liberal feeding in convalescence.—As the diet which I personally feel most justified in recommending, and which has been already described in detail, includes the use of solid foods early in convalescence, it will be unnecessary to add much on this subject here. It is, however, interesting to note that both Barrs and Marsden were led to use solids during the acute stage by the success which they had obtained by the employment of liberal diet in the period of early convalescence. Most physicians, with much experience of enteric fever, will agree that nothing reduces a prolonged swinging temperature in the convalescence of a patient more than the use of solid food, always provided the patient is really hungry. As an instance of what may be done in the direction, I may quote the daily menu of a patient of Barrs', who after eight weeks' fever was getting into a dangerously exhausted state, the temperature having assumed the remittent type, with evening rises to 100° F. and over, the morning readings being somewhat above the normal line. She had been very strictly dieted and was extremely hungry. She was placed on the following diet:—

First day. Morning temperature, 99° F. Breakfast: coffee, bread and butter, bacon and egg. Dinner: sweetbread, part of a chop, potato, stewed plums and sago pudding. Tea with bread and butter and sponge cake. Supper: porridge and milk. Evening temperature, 99·8°.

Second day. Morning temperature, 98·8°. Breakfast: coffee, toast, bacon, bread and butter. Dinner: lamb, potato, peas, custard pudding and stewed plums. Tea with bread and butter and tomatoes. Supper: porridge and biscuits. Evening temperature 100°.

Third day. Morning temperature 97·8°. Breakfast: coffee, toast, bacon, bread and butter. Dinner: cold lamb, potatoes, peas, rice pudding. Tea with bread and butter, a boiled egg, and tomatoes. Evening temperature 98·8°.

Thereafter the patient had the ordinary food of the family and the evening temperature was steadily normal after two days.

Without quite admitting the desirability of commencing by allowing such a large supply of food to a patient who had been strictly dieted, I should never hesitate in a case, where the fever had been prolonged, to give solids such as fish in small quantities, and potatoes well mashed in gravy as soon as the morning temperature has touched the normal line, or even sooner; and during the lysis, as recommended by Marsden, should the wasted and exhausted condition of the patient appear to call for it. The vast majority of patients, however, will do very well with a more gradual increase of diet at this period, especially if they have been carefully dieted throughout the fever. The general conclusion to be drawn from the study of these liberal dietaries is that they may be occasionally very useful but are not always necessary. The good rule is to treat the patient as an individual and not to be too much hampered by theories of dietetics. I may add here that, without being a keen supporter of intestinal antiseptics, such as salol, guaiacol, or naphthol, I think they may be especially useful in helping to limit any undue fermentation in patients who are being liberally fed. At a time when most of my cases were being treated with a liberal soft diet, those who had also intestinal antiseptics undoubtedly did better than those who had not.

The empty bowel theory.—Attention has recently been called by Ewart to the advantages of a diet which leaves little or no residuum. The object here is to give plenty of food to the patients, but to dispense with the fæces so far as possible. It is obvious that there are many advantages in such a method. There should be an absence of any irritating residue which may increase the process of ulceration, and Ewart throws out the hope that just as we have learned that phagedenic chancre and hospital gangrene are no longer held to be normal developments in pathology, so we may yet learn that severe typhoid ulceration is a preventable condition. That it may be so is indeed very probable but, so far as regards hospital patients, the mischief will usually have commenced before they come under observation. Any diet, however, which claims to limit the severity of the process, demands careful consideration, and the dietary outlined by Ewart contains many most interesting and valuable suggestions.

The staple food is whey given in quantities from 2½–4 pints in the twenty-four hours. This has, of course, been much used, especially in severe cases, by many practitioners, and is always worth trying when a patient cannot digest milk however carefully the latter is given. Ewart adds 10–15 grains of common salt to each half pint, with a view of correcting the deficiency in mineral salts which the ordinary milk diet entails. He advises that the deficiency in phosphates should be made up by giving periodical doses of one of the medicinal syrups. Sugar is also added to the whey, being useful as a food and having no residuum. The organic acids and essences contained in fruit and vegetables may be given in the form of watery extracts, carefully strained. Fruit jellies, especially apple jelly, are well taken by the patient, and vegetable soups should be given daily. The meat preparations and extracts are not recommended. To secure sufficient nitrogenous material white of egg is added to the whey, which is then peptonized. The yolk of one egg daily is allowed in divided portions. Clarified honey may also be used and is a valuable addition to the carbo-hydrate supply. Maltine is also useful in this connexion. As regards the fats, cream is the most useful and acceptable, either taken alone or added to the whey. One ounce is a sufficient daily allowance.

It is to be understood, for the first few days that the patient is under observation, that whey alone should be given, salted but with no other addition. When any meteorism has subsided, sugar, albumin, and cream may be added to it successively, the state of the patient and the condition of the stool determining each addition. Thereafter the vegetable soups, the fruit juices and jellies, and the honey are brought into use. Such a diet is certainly likely to leave little or no residuum. Ewart employs it in conjunction with an antiseptic treatment consisting chiefly of the use of paraffin and powdered charcoal. This it does not come into our province to discuss.

Starvation treatment.—The same idea which underlies the "empty bowel theory" is no doubt responsible for the attempts made to treat enteric fever with either no food by the mouth at all, or at the most with very small quantities. Thus Queirolo has recommended that feeding should be entirely rectal, a lemonade made up with a little hydrochloric acid being the only drink allowed. Provided that the bowel of a patient so treated was first emptied by a dose of calomel or other suitable purgative, such a method of dieting should secure complete rest for the affected parts and absolutely exclude the possibility of fermenting masses of partially digested material lying in the gut. The nutritive value, however, of rectal feeding in a prolonged disease is so limited that this method may fairly be regarded as a treatment by starvation.

Similar in its object and effects is the method suggested by Williams, who, believing that the exhausting diarrhœa of the fever is due to improper feeding, endeavours to secure that the bowel shall, as far as possible, remain empty. Only water is allowed in severe cases, sometimes for days at a time, and he regards half a pint of milk in the twenty-four hours as a liberal diet, seldom apparently exceeding this amount until the temperature is normal. The method seems drastic, but I have reason to know that the cases do remarkably well. I have often marvelled at the amount of starvation which a typhoid case can safely tolerate after a hæmorrhage, and it is only rational to suppose that the patients would support starvation even better before such a depressing complication had occurred. Under such a régime Williams probably more nearly attains the ideal of the "empty bowel" than any other observer. It seems almost incredible that patients so treated should occasionally gain in weight and that they do not in any case waste more than patients more liberally fed ; but it is, after all, obvious that, if food is not assimilated there is no benefit to be derived from it, and in many cases of enteric fever assimilation is undoubtedly extremely poor.

The theoretical objection to both these methods of treatment is that, if ulceration has once started, such a remarkably low diet would apparently give the intestinal lesions only a poor chance of repair ; on the other hand, it is possible that the absence of irritation would go far to counterbalance this defect, especially as the patients seem to stand their starvation so well. If plenty of water was supplied this would be more easily understood, but some of Williams' patients were limited, for a time at least, to one pint of water per diem, which seems a most inadequate amount.

The above are instances of a treatment which has often been attempted, and which is known in France as "Traitement à vide." While not prepared to recommend its adoption, I think that from it, as from the experiments in feeding with solids, there is much to be learned. It encourages us to starve, for two or three days if necessary, severe cases with marked gastric and intestinal disturbance, probably very much to their advantage. It is, however, unnecessarily severe for the average patient, even while we admit that in enteric fever there is no certainty as to what may happen from day to day.

Value of large quantities of water in enteric fever.—It has been seen above that a liberal supply of cold water to drink may be fairly considered as a necessity for the enteric patient, and that three or four pints should be the minimum allowance. The forced ingestion, however, of much larger quantities of water than this has been recommended as a systematic method of treatment, and therefore deserves separate consideration. About 14 years ago Débove succeeded in forcing 10 to 12 pints of water daily on his patients and his results were extremely good. More recently Cushing and Clarke have given 4 oz. of water every 15 minutes during the waking hours to their patients, and in this way amounts, varying from 8 to 14 pints were comparatively easily ingested. Besides this their patients had at least 3 pints additional fluid in the form of milk and albumin water in the course of the day. The effect of such a treatment is a very marked diuresis, and by this method it is hoped that the elimination of toxins is very much increased. While I have seldom, personally, succeeded in persuading patients to take more than 8 or 9 pints of water in addition to their other fluids, I have, like Cushing and Clarke, noticed a very marked diminution and improvement in such symptoms as headache, restlessness, delirium and other toxic manifestations, and such results certainly point to a clearing out of the toxins from the blood. It was found by Cushing and Clarke that their cases, which were being treated systematically on the usual hydro-therapeutic lines, required the cold bath less frequently, and when we remember that the chief merit of systematic cold bathing is the increased diuresis which it secures, such a result was only to be expected. They state that complications under this form of treatment, generally speaking, are rare, but that meteorism appeared to occur a little more frequently than usual. The latter has not been observed by myself, but I have not succeeded in giving quite so much water to my cases as have the American physicians. A lower mortality rate was observed in those patients whose daily elimination of urine exceeded 160 oz. The ingestion of this large amount of water has the effect of increasing considerably the excretion of chlorides which are usually, in enteric fever, retained. Thus assuming the average income of chlorides, when the diet is restricted to milk, to be 36 grains, the normal individual retains 15 grains, the ordinary typhoid patient 27 grains, and the typhoid patient who is receiving large quantities of water only 11 grains. The conclusion seems justified that the polyuria is able to counteract the excessive chloride retention in fever. Thus both clinically and experimentally it would appear that this free supply of water to the patient is of real advantage.

It would be interesting to know if there was any risk of protective substances in the blood being eliminated together with the toxins under this method of treatment. Such an objection is probably only theoretical, for as we have seen, the improvement of the toxic symptoms is such as to make us doubt that the resistance of the patient to the toxins is in any way weakened. Todd, however, considers that free diuresis, which he admits to be desirable, soon exhausts the system of its salts, which are necessary to preserve the integrity of the blood plasma and for the function of the leucocytes. He considers that the exhaustion of the salts from the blood tends to cardiac arrest. He therefore advocates the use of *saline beverages*, 10 grains of sodium chloride with 5 grains of potassium bicarbonate being dissolved in 8 oz. of water, the whole being flavoured with a teaspoonful of lemon juice. Five pints of this mixture is given in the day. The main object of the treatment is to maintain the alkalinity of the blood. It is interesting to note that Sollmann and Hoffmann, who investigated the cases treated by Cushing and Clarke, found that in these cases any addition to the chloride income was promptly balanced by an increased chloride output, so that, after all, the added saline is promptly excreted. But this, of course, in no way invalidates Todd's contention that it is useful while it is actually in the blood. Todd also holds that sodium chloride solution is better absorbed in the stomach than water, and that the dissipation of heat is very much assisted by the elimination of large quantities of water by the skin, lungs, and urine.

I consider that the free administration of water is of very great importance in the treatment of any case of enteric fever, but I am accustomed to regard 6 pints as a satisfactory allowance, anything over that figure usually involving the employment of special nurses and considerable worry to the patient. Any patient, on the other hand, who is willing to drink more I would certainly encourage to do so, but as a rule the severe toxic cases which require fluid most are those to whom it is most difficult to administer it.

General conclusions on diet in enteric fever.—Enough has been said to show that the practitioner has a wide choice of dietaries for typhoid patients. Each system has something in its favour, and it is by the judicious application of the suggestions we gather from each to our individual cases that we are likely to obtain the most satisfactory results. Thus, while following the rule that safety usually lies in moderation, and that extremes both in the direction of starvation and of liberal feeding may be with advantage avoided, we may not infrequently be confronted with cases in which the complete stoppage of all food substances on the one hand, or the early administration of solid food on the other, may do much to secure the successful recovery of the patient. My own feeling is that a fluid diet, chiefly consisting of milk, as indicated in the first part of this section, is the safest and, in the long run, the most advantageous in the acute stage of the fever, and that this diet should be rapidly increased in the early days of convalescence, due care being exercised in watching the effect of each addition. I can see no benefit whatever in starving patients with practically normal temperatures, clean tongues, and good appetites, and in any case we learn from the good work done by the modern disciples of the famous Graves, who "fed fevers," that food may be supplied with considerable liberality and without risk in the early convalescence of enteric fever.

DIET IN DIPHTHERIA

The extremely depressing character of this infection, and the great exhaustion which it entails, would appear to mark it out as a disease in which liberal feeding is especially indicated. On the other hand it is well to remember that the forcing of too much nourishment on the patient may easily induce vomiting, and in no disease is vomiting to be regarded as more dangerous, owing to the strain it is liable to put upon a heart which is too often much debilitated. In selecting, then, a diet for diphtheria it is as well, while fully recognizing the importance of maintaining the strength of the patient, to be very careful that the food allowed is light and easily digested. All patients, moreover, and children particularly, should be watched for any sign of difficulty in deglutition, a complication which may appear comparatively suddenly, and occasionally has been responsible for death by choking.

Diet in the acute stage.—As long as the temperature remains elevated, which as a rule is only for a few days, a fluid diet is perfectly sufficient, and this may be continued for some days after complete defervescence should the throat remain swollen or painful. The diphtheria patient, however, can usually swallow without much discomfort, and the difficulty of feeding in the acute stage is not nearly so great as is the case with a quinsy or as ordinary septic spotted throat. As in the other infectious diseases milk is by far the best and most convenient food. It must, of course, be given regularly and with due precaution, and it may be supplemented by the free use of ordinary beef or chicken tea. Should the pyrexia be prolonged, one or two beaten-up eggs may also be allowed in the twenty-four hours, as may calves' foot jelly and such foods as Benger's, plasmon, and other similar preparations. Remembering the importance of not overloading the stomach and causing an irritability which may be dangerous later on in the disease, it is usually better to wait till the temperature has fallen before making these additions. In the very severe cases, whether the temperature is elevated, normal, or subnormal, the simpler the diet is kept the better, and on the slightest sign of gastric irritability the milk may be with advantage peptonized. Should the patient appear much poisoned and the character of the pulse suggest a failing heart, the question whether to wake him every two hours for nourishment during the night may have to be seriously considered. In any case it is wiser to give something every four hours at least. Fortunately, in many cases of this sort the patient is drowsy, and is little disturbed by being frequently fed. Albuminuria at this stage need not, as a rule, modify the above diet. It frequently disappears early, and I cannot say that I have noticed that it is in any way affected by the food allowed. In diphtheria, as in the other toxic diseases, water and diluent drinks should be supplied liberally.

In the comparatively rare cases in which the inflamed and swollen condition of the throat is so marked as to prevent a reasonable amount of nourishment being taken, nasal feeding must be resorted to. Some suggest rectal feeding in preference, alleging the risk of the nasal tube inoculating the pharynx and œsophagus with diphtheritic material from the upper passages. In these days of serum treatment we may confidently assume that no such spread of the local condition is in the least likely to occur, and the value of rectal, as against nasal, feeding is so extremely limited that the latter should always be preferred. Unless there is very much septic, as well as diphtheritic infection, such cases may be said almost never to occur.

Diet in convalescence.—So far as diphtheria is concerned the term convalescence must be held to imply the period after the throat is free from membrane, a period in which the patient runs many of the most serious risks of the disease. In the majority of patients, however, the food may be increased from the moment the temperature touches normal, even if there is still some patching visible in the throat. Soft solids may first be given, milk puddings, baked custard pudding, oat flour porridge and farinaceous food generally. A little stewed fruit given with rice pudding encourages a child's appetite and may be safely allowed, as may fresh fruit such as oranges and bananas in moderation. Strong soups may now take the place of beef-tea, and eggs may be given with advantage either lightly boiled or served in a clear consommé. Fish may be added in one or two days and the patient's meals may be arranged as in health, milk or beef-tea being occasionally supplied in the intervals. The dietary might run on the following lines. First breakfast, porridge and milk. Second breakfast, two hours later, tea or coffee, bread or toast and butter, a boiled egg. Some time during the morning a glass of milk. Dinner, a good soup, fish and potatoes, milk pudding or cornflour with stewed fruit. Tea with bread, butter and jam—if desired a boiled or poached egg. Supper, a glass of milk, bread and milk, oat-flour porridge, or Benger's food, as preferred. During the night hot beef-tea once or twice as considered necessary. If this diet is well taken, chicken or rabbit or a cutlet can be given at dinner time.

It is not, of course, to be expected that every patient will manage to take so liberal a diet, but as a general rule diphtheria patients do best if they are well fed. The average convalescent, who feels quite well but who is kept rigidly in bed for fear of the appearance of sequelæ, can be trusted to assimilate the dietary indicated. Those who, though their acute symptoms have subsided, still look "poisoned" and who have markedly irregular pulses are best restricted to soft solids. I am not accustomed to make much modification of the diet even if albuminuria is well marked, unless the amount of urine is very much decreased.

The significance of vomiting in convalescence.—It is well to regard vomiting in diphtheria as of serious import until it has been proved to be the contrary. It may be merely the result of injudicious feeding, of a bilious attack, or of some other trivial cause. It may also be, and too often is, an early symptom of fatal cardiac failure. Even if this is not the case, the strain of vomiting, be the cause ever so trivial, may be too much for the heart muscle, which seldom escapes some degree of deterioration. The rule, then, is first to treat the vomiting as a serious event, and secondly to speculate as to its cause. All food by the mouth must be stopped at once. After a few hours' interval, if the vomiting has not recurred, a cautious attempt may be made to give a little peptonized milk. If this is vomited it is best to resort to rectal feeding without further delay, as to persist in attempts to feed by the mouth will only make matters worse. Rectal feeding is at best unsatisfactory, but with care it may tide the patient over the dangerous period. The bowel must be first thoroughly emptied by a simple enema. The nutrient injection may, of course, vary in composition according to the views of the physician. I usually prescribe the yolk of an egg in 2 or 3 oz. of milk, the whole peptonized. To this ½–1 oz. of cream and a dessertspoonful of brandy are added. Occasionally instead of the egg a few drachms of some meat juice such as bovinine are given. Boyd has recently drawn attention to the value of dextrose in nutrient enemata. This supplies the deficiency in carbo-hydrates. His prescription for a good nutrient injection is, the yolks of two eggs, 450 grains pure dextrose and 7 grains common salt in about 10 fluid ounces of pancreatized milk. Commercial dextrose is unfortunately too irritating to the bowel.

The nutrient enema should not exceed 4 oz. for a child. Adults can retain much more, and Boyd considers there may be some advantage in giving a large quantity, as some of the material occasionally passes above the ileo-cœcal valve. The syringes usually employed are not suitable for the purpose. It is better to use a funnel with a soft rubber tube and pour the fluid in very slowly. The administration of sufficient fluid is of great importance, as thirst is a most distressing symptom in these cases. A saline injection of 6–8 oz. in a child, or of 10–20 oz. in an adult is usually well retained, if given rectally one or two hours before each nutrient enema. The enemata may be given every four hours, or less frequently if the patient's strength appears to be well maintained. At least once in the twenty-four hours the lower bowel must be thoroughly cleansed by a large injection of hot saline, or of hot water with a very little soap. Occasional attempts at mouth feeding may be tried, iced brandy or iced champagne being often tolerated when nothing else will lie on the stomach.

Feeding in cases of paralysis.—When only the palate is affected the adult patient is usually able to swallow his food satisfactorily, without regurgitation through the nose, if he takes it sufficiently slowly. Children, even with slight degrees of palatal palsy, should never be allowed to feed themselves. They cannot, as a rule, be trusted to take sufficiently small quantities at a time, and should have their nourishment administered in teaspoonfuls by the nurse. Soft solids are often swallowed with less difficulty than fluids, and custard pudding and jellies are usually readily taken. In the more severe form of paralysis, affecting the pharyngeal muscles, which appears later in convalescence, nasal feeding must always be used. Even if the patient does not absolutely choke in attempting to swallow, particles of food are liable to reach the lungs and set up a septic pneumonia.

Feeding in tracheotomy and intubation.—I must confess to preferring nasal feeding after both these operations. Children very often swallow perfectly after tracheotomy, but it is as well to run no risks. After intubation infants as a rule swallow well, but older children are often nervous, especially with fluids, and are liable to have fits of violent coughing. The Casselberry position, with the child's head and shoulders lower than the rest of the body, undoubtedly makes swallowing much easier; but children tolerate nasal feeding so well that there is little to be gained by using any other method. The food, of course, must be fluid and will consist chiefly of milk, custard and meat juices. After the canula or tube is removed the child may be fed in the normal manner.

Alcoholic stimulants in diphtheria.—In my opinion diphtheria, if of average severity, is depressing enough to make the moderate use of stimulants advisable. It is doubtless the case that many patients can survive even a sharp attack without the use of alcohol, but it is also true that it is often impossible to predict with any certainty in which individuals a sudden heart failure is likely to occur. This being so, I cannot resist the feeling that, should such a tendency to syncope appear quite suddenly, those patients who have had comparatively recently even a small dose of alcohol will be less likely to succumb than those who have not had a similar advantage. The value of free stimulation in cases which have shown signs of a failing heart from the onset of the disease is unquestionable, and was often very well seen in the days before serum treatment. Nowadays, perhaps, we are a little too apt to attribute every improvement to the use of antitoxin. Believing, then, that alcohol may be of great value, it is my custom to prescribe it systematically to all cases which we would have unhesitatingly classed as classical diphtheria in the days before bacteriological examination was the rule, that is to say, to both severe and moderate cases of diphtheria. Cases, on the other hand, the diagnosis of which depends more directly on the result of the culture, do not receive alcoholic stimulants as a routine. Whisky is probably the most satisfactory form in which to give alcohol, and very small doses are given, unless the heart shows signs of failing, the routine dose being often as small as 30 minims every 4 hours for a child of 4 or 5 years of age, and a drachm for older children or adults. This is usually continued for the first 10 days and, if the pulse is not quite satisfactory by that time, for a week or so longer. If there is any tendency to sickness brandy is preferable, and if signs of definite heart failure with vomiting appear, there is nothing better than champagne. During the convalescence of adults port or a good Burgundy in suitable quantities is occasionally very useful.

DIET IN SCARLATINA

In our treatment of any of the acute fevers it is necessary to keep in view the conditions which may complicate its course and convalescence. Were it not for this there would be but little to say respecting the diet of scarlatina, and, even as it is, many take the view that this fever may be dieted on the same lines as any other acute infection. For many years physicians in planning a diet for scarlatina patients have been influenced by the comparative frequency with which acute nephritis and albuminuria are liable to occur in its convalescent stage, and many of the dietaries suggested have been therefore devised to act as a prophylactic measure against this particular complication. As in the case of the other fevers, I propose to state briefly the method of dieting which I am personally in the habit of employing. Thereafter diets which are more liberal or more restricted may with advantage be discussed.

Diet in the acute stage.—This stage is in the majority of cases brief, seldom lasting more than a week in the simple forms of the disease. Any elaborate or complicated diet would appear, therefore, to be out of place, as the patient may be expected to maintain his strength quite satisfactorily on a fluid régime. During the first twenty-four hours of the fever vomiting is so frequent a symptom that the patient may well be left alone. Later, after the appearance of the rash, milk is, as a rule, quite sufficient. The milk should be given with the same precautions as were indicated in the section on enteric fever. As the temperature falls the amount given may be increased gradually if the patient takes it well and is at all hungry. I am not accustomed to give meat broths at this stage. If given at all they should be weak. Water should be supplied freely to the patient, and there is no objection as a rule to alkaline aerated waters should he prefer them. Fruit juices to flavour the drinks given are often very refreshing and their use may be encouraged. Weak tea may also be allowed in moderation.

In the more prolonged forms of the fever, in septic scarlatina (scarlatina anginosa) for example, it may be necessary to allow somewhat more than a purely milk diet. Arrowroot and other starchy foods, thin oatmeal gruel, Benger's food and other similar preparations may all be given, as may well-stewed fruit if it can be swallowed. The difficulty indeed often is, in the septic form of the fever, for a patient with an acutely inflamed and ulcerated throat to swallow anything but fluids. Occasionally fluids themselves cannot be swallowed in sufficient quantity to adequately nourish the patient. In such cases nasal feeding must be resorted to, and its systematic use often has a very beneficial effect on the condition of the mouth and fauces which, being thoroughly rested and also relieved from the fermentative action of food substances clinging to them, sometimes clean up with remarkable rapidity. Broadly speaking, I consider the use of meat extracts and beaten-up eggs undesirable in the acute stage of scarlatina, but there is no need to hesitate to prescribe either should the patient not appear to be adequately supported by the above diet. Stimulants, again, are usually undesirable, but in this type of the fever often necessary.

The malignant or toxic type of scarlatina offers few opportunities for dietetic treatment. Its course to a fatal termination is usually rapid, and vomiting is so often persistent that we are frequently reduced to rectal feeding. As, however, diarrhœa is also present in many cases, even this may be found to be impossible. Everything should be done to force fluids on the patient and to favour the elimination of the toxins. If water is vomited saline injections by the rectum, under the skin, or into a vein may occasionally save an apparently hopeless case. Stimulation, preferably with brandy, or perhaps champagne, should be very freely resorted to.

Diet in convalescence.—When the temperature of a simple case has reached normal, the milk diet may be supplemented by farinaceous foods. In the morning thin oatflour porridge with plenty of milk. A little later a second breakfast of tea and bread and butter. At dinner time, rice and other milk puddings, stewed fruit with plenty of milk, and, if enjoyed, milk soups flavoured with vegetable juices. In the afternoon, tea with plenty of milk, bread and butter and jam. At supper time bread and milk, or porridge with milk, and a slice of bread if desired. A good allowance of milk, a pint at least, and preferably more, should be taken in the twenty-four hours. Water should also be supplied freely. If febrile complications, such as arthritis, should occur, this diet may still be given if the patient has sufficient appetite.

There is no necessity in my opinion to increase this dietary till the period at which nephritis occurs most frequently is safely passed. Exceptions can be made in the case of adults, fish being allowed from the commencement of the third week. Otherwise it will be withheld till the middle of the fourth, when it may be allowed, as may white meat, chicken or rabbit, meat soups and, a little later, meat and eggs. In young children, eight years and under, it will seldom be necessary to give more than white fish. Potatoes may be given at any time in the stage of convalescence, as may fresh fruit. I am far from saying that a much more liberal diet might not be given with perfect safety, as indeed the practice of many authorities proves, but the above appears to me to be quite sufficient and is not likely to overtax the kidneys.

Liberal diet in scarlatina.—Those, on the other hand, who believe that the kidneys may safely be disregarded and that the occurrence of nephritis is in no way influenced by early feeding, are more liberal in their supply of food to the patient. Foord Caiger, holding that there is no evidence that nephritis has ever been induced by the administration of a diet containing a moderate amount of nitrogenous food, gives a quite liberal diet, even in the acute stage. Soup, beef-tea, and beaten-up eggs are all permitted in the febrile period. Solids are given as soon as the temperature is normal, and the condition of the patient's throat permits. Bread and milk, custard, milk puddings, lightly-boiled eggs, and thin bread and butter with the crust removed are the first additions to the diet. In two or three days he extends this diet so as to include fish, poultry, and meat. A similar dietary is recommended by Goodall, and it appears that meat is usually given comparatively early in the great fever hospitals of the Metropolitan Asylums Board. Green vegetables are recommended in the early days of convalescence. The value of fruit is also insisted on.

Restricted diets.—Jaccoud, Moizard, and many of the French writers attach much importance to a purely milk diet (*régime lacté absolu*). This should be invariably used in the febrile stage, and should be continued with only slight addition, such as chocolate and coffee, for a full week after the temperature is normal. Thereafter eggs, meat and vegetables are allowed. Fish, which in this country we usually prescribe in preference to meat, is excluded altogether, being placed in the same category as pork. Even after the diet has been thus extended the patient is expected to drink from 2–4 pints of milk daily. A weak point in this diet is the fact that the nitrogenous additions are first made in the third week, at the very time, in other words, that we are beginning to expect nephritis. Jaccoud claims, however, that this condition never follows in cases so dieted. This is not in accordance with my own experience, as I have seen nephritis supervene in cases in which nothing but milk has been given. The method of Forchheimer is more logical. He allows fairly liberal feeding during the febrile stage when most of us are content with a fluid diet. From the beginning, however, of the second week until the end of the fourth, he restricts the diet to milk alone. He insists on the importance of supplying much fluid to assist the elimination of waste products, and considers that milk, "when subjected to the action of bacteria, will produce fewer harmful end products of digestion than any other article of food." At the end of the fourth week carbo-hydrates are first tried. If no harm results meat is added, and normal diet is resumed. Even stricter dietaries than the above have been suggested, such as milk and milk alone for six weeks, or milk with carbo-hydrates, such as rice and arrowroot.

Influence of diet in producing nephritis.—There is certainly little evidence that the occurrence of nephritis is in any way influenced by the use or by the restriction of nitrogenous substances. On the other hand, it would appear only reasonable in a disease in which nephritis is liable to occur to put as little tax as possible on the excretory powers of the kidney. The complication may occur at any time during the fever and convalescence, but the usual period at which it appears is from the sixteenth to the twenty-sixth days. For instance, in a series of 134 consecutive cases of nephritis, 88 occurred within the 10 days named; and of these 68 had their first symptoms between the twentieth and twenty-fourth days inclusive. Whether we regard the cause of the inflammatory process as due to the direct invasion of the kidney by the streptococcus, and that micro-organism has undoubtedly been demonstrated in the organ, or whether we prefer to believe that for some reason or other there is a specially plentiful discharge of irritating toxins about this particular period, the excretion of which proves too much for the kidney, any efforts to prevent the renal tissue becoming depressed either by chill or by hard work, seem perfectly logical. We do not believe nowadays that chill alone will cause nephritis, but it may certainly facilitate its occurrence by lowering the resistance of the kidney. May not the work entailed by the excretion of large quantities of nitrogenous food have a similar effect? Recently it has been suggested by those who hold the streptococcus responsible for the inflammation that prophylaxis is best directed to the antiseptic treatment of the throat. This is no doubt excellent, but, to my mind, the difficulty of accepting this theory of causation is the extraordinary regularity with which nephritis occurs at a definite period of the fever, the end of the third week. The streptococcus has been in the blood from the first. Why has it not attacked the kidney earlier? It has shown no such delay in causing arthritis, usually a much earlier complication. Inflammations of the middle ear occur throughout the fever, early and late, but do not group themselves into a particular period of about 10 days. The connexion of the throat and ear, moreover, is much more apparent than that of the throat and kidney. I am therefore inclined to regard nephritis as due to an excretory difficulty and, as such, likely to be influenced by the diet employed. Still, it is only fair to admit that, as far as statistics go, there is no proof that diet exerts such an influence in prophylaxis, for whereas Foord Caiger reports an incidence of 11·9 per cent of nephritis and late albuminuria in 10,983 consecutive cases of scarlatina, dieted presumably on the liberal lines indicated above, of 4,436 patients of my own, who had a more restricted dietary, 11·02 per cent developed nephritis or albuminuria, a difference which can be totally disregarded.

If, however, the more moderate diet is considered both sufficiently adequate and theoretically safer, it is always as well to consider the age of the patient. Most cases of nephritis occur between the ages of 3 and 8 years, and in older children and young adults more latitude may be allowed in increasing the amount and character of the food allowed.

Diet in complications.—On this question there is little to be said. With the exception of nephritis, the complications which are liable to occur in the convalescence of the fever demand, as a rule, no modification in the diet. Should considerable **pyrexia** accompany any of them, it is only reasonable to return to fluid food, or even to restrict the patient entirely to milk. If the appetite remains good, a slight degree of pyrexia may be disregarded and the ordinary diet of convalescence continued. In **nephritis,** however the patient has been fed previously, a milk diet should at first be insisted on. For a day or two, even, a little arrowroot and water with no milk may be given, or it may be advantageous to limit the patient to whey. As long as the urine is restricted in amount, or blood remains in it, it is wiser not to go beyond the milk diet. Fluids must be liberally supplied in order to assist the elimination of waste material by the skin and bowels. A useful drink to give is the so-called "Imperial drink," which is made by dissolving a drachm of acid tartrate of potash in a pint of boiling water, and flavouring with lemon juice and sugar. The mixture is allowed to cool before use. Barley water may also be used. Recently the question of limiting the amount of chlorides given to the patient has been much considered, and if the food is increased as the complication continues, it is probably wiser to limit the amount of salt taken. I am not, however, in the habit of adding much to the milk diet if the amount of albumin remains considerable, unless the condition is prolonged beyond three weeks. If at that time the albuminuria still persists, the best way to prevent it becoming chronic is undoubtedly to feed. Assuming that the patient has hitherto had nothing more than milk and milk puddings, the addition of one or two boiled eggs to the day's diet is my first step. Caiger points out that in this way the loss of albumin may be to some extent replaced, and since first trying his method some years ago I have always used it, being entirely satisfied with the great improvement in the colour and strength of the patients and the rapid disappearance of the albuminuria. It is just at this time, also, that we are accustomed to prescribe iron, and it is probable that the comparative richness in iron possessed by eggs may have something to do with the good results obtained.

The question of providing a diet in nephritis from which chlorides are, so far as possible, excluded may be worth considering. Deléarde recommends such a régime for scarlatinal nephritis and considers that milk, containing as it does 15 grains of salt, or more, to the pint, is by no means an ideal diet for this complication. He suggests as a prophylactic against nephritis a dietary containing eggs, dried or fresh vegetables, and even a little meat. Fish, fats, jam, and bread made without salt are also allowed. As the diuretic effect of milk may be missed, other diluent drinks must be given freely. When the nephritis has occurred a very similar dietary may be employed, one of Deléarde's patients receiving two eggs, purée of rice with sugar, and potatoes. A diet so elaborate as to require the bread being especially made is too troublesome to give when so comparatively few cases develop nephritis. In the presence of the complication, however, especially if there is much œdema, the system deserves a trial.

DIET IN MEASLES

Diet in the acute stage.—The usual rules for feeding in fever may be observed as long as the temperature remains elevated. Milk in regular quantities at regular intervals is usually quite sufficient. If looseness of the bowels is present, it may be modified by the addition of suitable quantities of lime-water. The short duration of the febrile period, lasting as it does seldom more than a week, renders it quite unnecessary to attempt to feed up the patient, who, as a rule, has little or no inclination for food. In very feeble or badly nourished children, or in those who may have contracted measles after some exhausting disease it may, of course, be necessary to be more liberal. In such cases the suggestions for dieting in the acute stage of enteric fever may be found useful. Water must be supplied liberally to all patients, and there is no objection to orange or lemon juice being used freely to flavour it.

Diet in convalescence.—When the temperature has touched normal, eggs, farinaceous food, milk puddings and similar preparations may be given, and one or two days later the diet may be increased by the addition of white fish, potatoes, and stewed fruit in moderation. There need be little or no limitation put upon the dietary of healthy adults in this stage. In their case digestive complications are uncommon. With children, on the other hand, and particularly young children, it is well to exercise some caution in making additions to the diet. Diarrhœa may occur at any period of measles, and may be sometimes very intractable in convalescence. How far the enteritis of a dysenteric type, which is not infrequently seen a week or ten days after the eruption, is due to the measles poison itself, or how far to a superadded infection affecting a weakened mucous membrane need not be discussed. But as long as we recognize that diarrhœa of this type is often a real danger in convalescence, it is obviously foolish to give anything to the patient which is likely to encourage looseness of the bowels or to be badly digested. I have seen an ugly outbreak of what might fairly be described as dysentery occur in a group of children who were allowed a thick vegetable soup, the other children in the same ward, who had been more rigidly dieted, escaping. Undigested vegetable matter was found mixed with the blood and mucus in the stools. A diarrhœa of this sort once set up is exceedingly difficult to keep in check, and in weakly children may be fatal. Strong meat or vegetable soups, therefore, should not be allowed, and vegetables and fresh fruit, except oranges, are usually undesirable. Especially harmful may be the grapes which parents often seem so desirous of giving to their children. On the other hand, weak chicken-broth, with a little rice added, may be allowed, and this with white fish, mashed potato, milk puddings, jellies and bread and butter will be amply sufficient for a fortnight after the disappearance of the eruption, when normal diet may be resumed.

As regards **the complications** of measles there is little to be said. It is often not easy to maintain adequately the strength in **broncho-pneumonia.** The dyspnœa and the tendency to cough make mastication and swallowing a matter of considerable difficulty, and it requires careful attention on the part of the nurse to see that the child receives enough nourishment. The marked wasting which often accompanies this condition, and the tendency of the lungs to become tubercular, renders liberal feeding almost a necessity. In addition to milk, or whey, albumin water, beaten-up eggs, raw meat juice, and such foods as plasmon, sanatogen, etc., should be given. I have found the open air treatment of broncho-pneumonia of the greatest service in increasing the desire for food on the part of the patient. Only too often the appetite is entirely lost, and everything should be done to encourage it. Half the success of open air treatment depends on this increased willingness to take nourishment.

Of the other complications **enteritis** alone requires mention. This also may last a considerable time and cause much wasting. I usually restrict these patients to milk and lime-water, with occasionally a little raw meat juice or bovinine. Albumin water may also be given.

Alcoholic stimulants in measles.—These are seldom required in the acute stage, and are only necessary in the prolonged complications. Cases of broncho-pneumonia are often benefited by free stimulation, but there is no need to prescribe alcohol as a routine. In enteritis, again, it may be necessary to stimulate, and brandy should be given for choice. Young children take white wine whey very well, and I have found it useful in both the complications mentioned.

WHOOPING COUGH

Diet in the catarrhal stage.—As the appearance of the whoop is usually the first certain sign of the disease, the question of diet in this prodromal period needs little or no discussion. It is only seldom that patients in this stage come under our observation. If there is any fever a fluid diet is indicated, and this should be of as bland and unstimulating a character as possible. Milk, supplemented occasionally by meat broths, is all that is required.

Diet in the paroxysmal stage.—It is when this period of the disease commences that we have seriously to consider the best means of feeding the patient. We have often two difficulties to contend with. Firstly, a paroxysm, coming on shortly after food has been given, is very liable to empty the stomach in the act of vomiting, which so frequently follows the whoop. Secondly, some children learn by bitter experience that the giving of food excites the cough, and as a result firmly resist any attempt made to feed them. To force food upon such patients usually results in their acquiring an unpleasant habit of deliberately rejecting from the stomach whatever is given.

It is not only, however, the risk of the food being vomited or refused which has to be considered. We must also recollect that gastric irritation, whether from overloading the stomach or from unsuitable food, undoubtedly excites the cough and, therefore, whatever is allowed must be given only in small quantities, and must be also very digestible. The stage of the paroxysm is, moreover, often so prolonged and so apt to exhaust the patient, that it is highly desirable to supply a liberal amount of nourishment, in order as far as possible to prevent the wasting, which is frequently a striking feature. In hospital practice, particularly, liberal feeding may be of paramount importance from the very first, as the majority of patients have suffered from much vomiting and from improper dieting before admission. The difficulty of giving them sufficient food is made no easier by the fact that their digestion has often been temporarily ruined before they come under observation.

There is, of course, a clear distinction to be drawn between children of different ages. Children of over five years of age are, as a rule, not difficult to feed. They are able to run about and often enjoy a healthy appetite. Unless they have been debilitated by a complication or by previous illness, they are perfectly capable of assimilating an ordinary light diet. I find in hospital practice that the admirable rule laid down for feeding in whooping cough, namely, to feed immediately after a paroxysm so as to allow time for digestion before the next spasm, is impossible to carry out for all cases, unless a very large nursing staff is employed. When a fairly liberal diet, including a considerable proportion of cooked food, is given, such a method is impossible for a large number of patients. Even if an otherwise healthy whooping cough patient vomits the greater part of his dinner at once, he is usually perfectly ready to take it over again and retain it, if he is given the chance, as he should be. All children, then, who are able to be out of bed and who are over two years of age are allowed ordinary meals as in health, suitable to their age, and usually consisting of white fish, potatoes, occasionally minced meat, eggs, milk puddings, oatflour-porridge, and bread and butter. As long as the patient does not appear to be losing weight, and if the paroxysms are not unduly frequent or severe, the fact that the food is to some extent vomited, is a matter of very small importance. In private practice, where it may be possible for a nurse to devote her whole time to one patient, even in these sthenic cases the meals may be so arranged as to be given just after a whoop, as the interval between the paroxysms is often fairly definite. In this way some loss by vomiting may be avoided.

If, however, the case is more severe, the greatest care must be taken. It may be found, for instance, that the paroxysms are exceptionally frequent, and that a large proportion of the food ingested is vomited. Or the patient may appear to be losing weight and, perhaps, is not properly assimilating the food which he retains. In such cases, and in the prolonged broncho-pneumonias which are so frequently the cause of death in this disease, it is wiser to restrict the food to fluids and to give small quantities at frequent intervals, if possible, just after the whoop. A certain amount of this is usually digested, even if the vomiting with the next paroxysm is severe. I usually feed my patients chiefly on milk, often given with lime-water to correct any gastric acidity, and on small amounts of meat juices or extracts. Malt foods appear to be sometimes of advantage, and most of the children take Benger's food and other similar preparations well. The milk is always peptonized in the worst cases, and occasionally albumin water is added. In the less severe cases, milk puddings and starchy foods may be given, but as Eustace Smith points out, anything which is liable to cause fermentation or acidity is better avoided. Under this heading he classes farinaceous puddings, jam and fruit, all of which are harmless enough in older children, and mild cases, but are certainly better dispensed with in the type of case we are at present discussing. It must be remembered that gastric disturbance may do much to curtail the short snatches of sleep which such patients enjoy between the spasms, and so increases the nervous irritation which is so marked a feature in a bad case of whooping cough.

Individual cases may present very marked differences. Trousseau held that solid food was better digested than liquid, and occasionally even in severe cases this dictum may be remembered with advantage. I seldom, however, allow solids in a really bad case, whether pyrexia is present or not. In cases of moderate severity, if solid food seems to make the patient worse, soft solids may be used, such as porridge, rusks or sponge biscuits soaked in milk, bread and milk, and so on. Dry, solid food which may leave irritating crumbs in the fauces is very liable to excite the cough. Again, in the worst cases, if milk is not tolerated, it is always worth while to make a trial of whey. This is often most useful in infants.

If the patient refuses food altogether, everything should be done to persuade him to eat, and I often am willing to tempt such a child by allowing him anything in the way of food that he fancies, even if the article demanded does not appear very suitable. Rectal feeding is so unsatisfactory that we should try everything possible before resorting to it. Occasionally, however, it is our only resource. As regards the dieting in broncho-pneumonia, which should, generally speaking, be fluid, I have noticed, as after measles, that treating the patients in the open air makes them much easier to feed, a remark which, after all, applies to all cases of whooping cough. The disease is, in my opinion, far too frequently nursed in close rooms and artificial atmospheres, and under such conditions the difficulty in inducing the patient to take sufficient nourishment, always great, will be appreciably increased.

INFLUENZA

The manifestations of influenza are so exceedingly variable that it is difficult to lay down hard and fast rules for the dieting of the disease. It is, however, so remarkably depressing in its effects that, generally speaking, a generous dietary and a certain amount of stimulation would appear to be indicated. This may be started from the first in cases which have little or no pyrexia. In those, however, in which the fever is considerable, the usual rules for feeding in the acute stage of fevers must be observed, the milk diet being freely supplemented by meat extracts, beef-tea, and suitable protein preparations. In the gastro-intestinal form of the illness it may be necessary to add lime-water to the milk or to peptonize it, and to limit the meat preparations to those which are not liable to increase the diarrhœa, such as raw meat juice, bovinine, or Brand's essences. Cases in which the diarrhœa is almost choleraic will require free stimulation with brandy.

Diet in convalescence.—It is not every patient whose appetite requires to be tempted in convalescence after influenza. Many, indeed, have an appetite which is quite inordinate and are ready to eat much more than they would in health. There is no reason to limit the diet in such cases. A liberal dietary in normal lines, with a glass of milk or a cup of beef-tea given between meals, may be safely allowed. But for the average patient, especially for those who have suffered from that prolonged form of the disease which is not infrequently mistaken for enteric fever, it may be necessary to increase the dietary gradually, encouraging the appetite by the variety of the food prescribed, and sustaining the strength by frequent small meals. Oysters, sweetbread, and white fish, such as whiting, are all suitable in the early days of convalescence. Later chicken, game, or a well-cooked cutlet may be permitted. Strong soups, plenty of fresh milk, eggs lightly boiled, poached, or beaten up with milk and brandy may be given between the principal meals.

Alcoholic stimulants in influenza.—As is the case in diphtheria, it is probably safer to over-stimulate patients suffering from influenza than to allow too little alcohol. While quite admitting that there may be some risk of a patient acquiring an alcoholic habit in the period of prolonged depression which so often follows the disease, I am convinced that this depression may be often warded off by the judicious administration of alcohol in the acute stage and in the early days of convalescence. A little alcohol, moreover, given in convalescence aids the digestion and stimulates the desire for food, and if its amount is carefully regulated and its use strictly limited to meal times, I have seen no harm whatever result from its employment. In the febrile stage good whisky or brandy are preferable; later, it is wiser to prescribe wine with lunch and dinner. Port or Burgundy will probably be found most suitable if they are well taken. In very depressed cases a little champagne sometimes works wonders. Many physicians must have noticed the extraordinary toleration for alcohol which some patients appear to have after influenza, and if its administration is not too long postponed, there will be little difficulty in persuading the convalescent to dispense with it afterwards.

OTHER INFECTIOUS DISEASES

Very little need be said regarding the dieting of other infectious diseases. All may be safely treated more or less on the lines indicated in the preceding pages. The **continued fevers,** such as **typhus** and **relapsing fever,** should be handled very much as enteric fever. At the slightest sign of diarrhœa in the former, it is well to stop beef-tea or other meat broths at once, and to add lime-water to the milk, substituting brandy for whisky if the patient has been previously stimulated. Diarrhœa, when it does occur in typhus, is apt to be most intractable, and sometimes appears to determine a fatal result. **Smallpox** is one of the diseases which should be liberally fed, especially in the secondary fever, which is usually most exhausting. There is no reason to keep solids from patients in this stage, if the condition of the mouth permits mastication and if the digestion remains fairly good. A good time to take the opportunity of feeding liberally in this disease is the comparatively apyrexial interval between the primary and secondary fevers. This gives the patient a good start for the suppurating stage, and is likely to be of much benefit to him if later on there is a real difficulty in providing sufficient nourishment. **Chickenpox** and **German measles** are such mild infections and have, as a rule, such a short febrile period that normal diet need seldom be stopped for more than two or three days. In **mumps** the only difficulty is a mechanical one, the pain which is caused by attempting to open the jaws. The diet should be fluid and, if necessary, may be sucked through a tube. In **erysipelas,** unless the pyrexia is very considerable, patients usually take soft solids well in the febrile stage, and if suppuration occurs, it is as well to be liberal in the dietary. **Cerebro-spinal meningitis** may offer difficulties partly owing to the frequent vomiting, partly mechanical from the extreme retraction of the head. The vomiting seems to be of nervous origin, and between the attacks the patients may take a practically normal diet, particularly if the case is chronic, as the wasting is often extreme. The mechanical difficulty in swallowing is best combated by the nasal tube. Liberal feeding, whenever possible, should be the rule in this disease.

DIET IN TUBERCULOSIS

CHAPTER XI

DIET IN TUBERCULOSIS

By Noel Dean Bardswell, M.D., M.R.C.P., and John Ellis Chapman, M.R.C.S., L.R.C.P.

Tuberculosis is one of the wasting diseases, and the rationale of its treatment consists in improving general nutrition, repairing waste, and in increasing what we know as the resistant and recuperative powers of the human body ; in this treatment dietetics form one of the most important factors at our command. It is not a simple matter to generalize when speaking on the subject of the dieting of tuberculosis. The disease may manifest itself in such varied forms ; it may be very acute, for example, as a general infection, or the morbid process may be quite localized and give rise to little or no constitutional symptoms ; very often, as in the case of pulmonary tuberculosis, for instance, the disease runs a protracted and chronic course with intervals of more acute exacerbations. The signs and symptoms, then, of tuberculosis differ considerably, according to the character of the infection, and the part, or parts, of the body affected ; for this reason, the dietetic indications in patients suffering from this disease may vary a good deal. The diet, for example, which is in every way adequate for a patient with a limited and quiescent lesion in the lung, and whose body weight is in excess of his normal, will usually be found to be quite unsuitable for a patient with extensive and active disease in the same situation, associated with high fever and general constitutional disturbance. Tuberculosis of the larynx, associated with dysphagia, and the common complication of consumption, hæmoptysis, both require special dietetic treatment ; tuberculosis of the intestines and kidneys, and the various dyspepsias due to tubercular infection, also have their special dietetic indications. Speaking generally, the principles underlying the dietetic treatment of all types of tubercular disease are the same, but in the case of disease of certain organs, there are special indications to be considered. We may, then, conveniently discuss the subject of dietetics in tuberculosis in two sections (1) the dietetic treatment in tuberculosis generally, and (2) the special dietetic indications in tuberculosis of various organs.

THE DIETETIC TREATMENT IN TUBERCULOSIS GENERALLY

Our researches upon the dietetics of tuberculosis have been carried out in the course of some eight years' residence in sanatoria for the treatment of this disease. The patients we have treated, although they have been for the most part patients suffering from pulmonary tuberculosis, have included a good number of those suffering from tuberculosis of other organs, more especially of the larynx and of the intestines; a fair proportion of cases of surgical tuberculosis, such as bone and joint disease, lupus, etc., have also been observed. Our conclusions, then, as to the broad lines upon which the dieting of tuberculosis should be based have been formed as the result of observations upon a large number of patients suffering from tuberculosis in various regions, and for this reason we think that they may be taken as having a general application in the treatment of the disease. Opinions as to the best principles upon which diets for the treatment of tuberculosis should be constructed have differed very much, and at the present time the practice of physicians in this respect varies very considerably. An interesting illustration of the fact is afforded us by the statistics collected by Irving Fisher of Newhaven, in America, for the annual meeting of the National Association for the Study and Prevention of Tuberculosis held at Washington in May, 1906. The results of his inquiry are published in the *Transactions* of this Society (1906). Fisher states that "Letters of inquiry were sent out to 95 of the leading sanatoria of the world of which 63 were in the United States, 2 in Canada, 13 in Germany, 11 in Great Britain, and the remainder in France, Austria, Norway, Switzerland, and Russia. Very few" (less than 20 apparently), he continues, "supplied any measured data, and in most cases the statement of the food consumed was given only in a general way."

In regard to the question of the quantity of food consumed, Fisher found that of 64 sanatorium physicians, 28 were distinctly in favour of the system of forced feeding, and 29 were distinctly reactionaries against it. In the table of measured data which will be found in Fisher's Appendix, it will be seen that the dietaries range all the way from 2,500 calories to 5,500 calories, and have a protein value of from 160 to 300 grammes. Commenting on these facts, Irving Fisher writes: "Naturally, not all of these standards can be correct, and if we are to believe that there is any virtue in physiological economy, we must conclude that those sanatoria which use the lowest standards consistent with weight-gaining must be more nearly on the right track."

In conclusion, Fisher sums up the present position with regard to the question of the dieting of consumptives in the following words: "There is as yet very little known with certainty as to the most efficient diet in the treatment of tuberculosis or the extent to which this diet should be individualized. In order to determine either the standard or individual diet, much study and accurate observation are needed."

The object of our researches was to determine (1) the best principles upon which to construct diets for the treatment of tuberculosis and (2) if possible, to arrive at a standard diet suitable for the treatment of the average tubercular person.

We may say that it is clearly impossible to construct a dietary which is suitable for the treatment of all types of tuberculosis and for every individual sufferer from this disease. To attempt to do so would be to attempt as impossible a task as that of constructing a dietary which would be suitable for every one enjoying normal health, irrespective of sex, age, or occupation. However, in the same way as it has been possible as the result of prolonged scientific research and observation to formulate the essential principles upon which diets for normal individuals should be constructed, so it should be possible to determine the principles upon which diets should be constructed for the use of those suffering from tuberculosis. Further, it seems reasonable to assume that by continued accurate observations upon a large number of patients, a standard diet can be determined which is suitable for the treatment of the average tubercular patient, and which, with slight modifications, either by way of increase or decrease in some of its constituents, should be suitable for any individual suffering from this disease.

Method of observation.—Every patient on admission was carefully examined and observed for a day or two. This enabled us to estimate the extent and activity of the disease, and to ascertain the amount of fever present, the degree of emaciation, and to some extent the general constitution of the patient, and more especially the condition of his alimentary tract. We next estimated the nutritive value of the diet which was physiological, i.e. adequate for the requirements of the individual patient when in normal health and up to his normal weight. We then constructed a diet for the patient, in which the chief constituents of his physiological diet, viz., protein, fat, and carbo-hydrate, were increased in certain definite amounts. During the course of our observations we varied the amounts of the increase in protein, fat, and carbo-hydrate considerably in different cases, and in many individual cases we observed their progress on diets of varying nutritive value.

As a matter of routine practice we increased the physiological diets of patients in the several chief constituents according to the degree of activity of the disease and the amount of emaciation present in any individual case.

In every instance the physiological diet for the individual patient when up to his normal weight and in normal health was taken as the basis for his sanatorium dietary. The diet as prescribed thus represented the physiological diet, with the addition of certain definite amounts of protein, fat, or carbo-hydrate. The diet prescribed was given to the patients in accurately weighed-out and measured amounts, and after the completion of every meal, any food-stuff that was left was also accurately weighed. By this means we obtained definite data as to the exact amount of the various foods taken by each patient throughout the whole course of treatment.

Careful clinical observations were always made with regard to the progress of the lung disease, alterations in body-weight, improvement in general health, etc.

In many cases, metabolic examinations were also made. Sometimes these observations were made during a four-day period once a month ; in other cases, they were made daily for periods varying from a week to three months. The points especially studied were (1) the absorption of fat and nitrogen, (2) the amount of excreted nitrogen, (3) the form in which the nitrogen was excreted, viz., whether simple or in the more highly elaborated form, and their percentage relation. (4) The amount of intestinal putrefaction as evidenced by the ratio between the aromatic and the alkaline sulphates excreted and the amount of indican.

General principles regarding increase of protein, fat, carbohydrate and calorie value.—Generally speaking, a person suffering from tuberculosis requires a more generous diet than is physiological for him when in ordinary health. There are, as has been already noted, three chief constituents of a diet, viz., protein, fat, and carbo-hydrate. The question is, in which constituent and to what extent should the increase be made ? Some physicians with considerable experience in the treatment of tuberculosis advise that the increase be made in protein sparers, especially fat, while others advocate a very generous increase of all the constituents. Our experience is that the morbid process clears up better and general health improves more rapidly when patients are treated with diets richer in protein than those usually taken in health. We have, for instance, in the case of patients whose progress has been somewhat stationary, noticed distinct improvement immediately follow the addition to their diets of more protein. In similar cases, when a comparable increase has been made in the carbo-hydrate and fat, the protein intake remaining the same, there has not been the same improvement. Theoretically, one might expect equally good results to be associated with the increased use of protein sparers, and an actual increase of protein; in practice we have not found this to be so. It seems possible that the beneficial effects of an increased protein intake may be in part accounted for by the extractives contained in the meat. We have found, however, that when using a diet containing no meat at all, and in which the protein is given chiefly in the form of milk, pulse and oatmeal—in which the amount of extractives is negligible—we obtain results as satisfactory as when prescribing protein chiefly in the form of meat. Protein produces a stimulating effect upon the general body metabolism, and thus has a beneficial influence upon general nutrition ; the value of an increased protein intake in the treatment of tuberculosis is probably thus explained.

With regard to the **amount of the increase of protein** we have observed the course of tubercular disease in a large number of patients treated upon diets containing daily amounts of protein ranging from 150 grammes to 250 grammes, and our experience has been as follows : excellent results both from clinical and metabolic standpoints have been obtained when using diets containing 150 grammes of protein daily. Increasing the intake of protein beyond this point, viz., 150 grammes daily, is not associated with any better clinical or experimental results ; on the other hand, we have found that large amounts of protein may do actual harm. Metabolic investigation shows that with a very large protein intake, a very large proportion of the nitrogen ingested is immediately excreted, and throws a considerable strain upon the alimentary and excretory organs, the amount of nitrogen excreted in less completely oxidized form is increased, and there is evidence also of increased intestinal putrefaction. Our experience is, then, that the increase in protein in any individual case should be some 25 to 30 per cent on the amount of protein contained in his physiological diet ; this, on an average, works out at some 150 grammes daily.

Fat and carbo-hydrates.—The necessity for increasing the energy-giving foods of the dietary when treating tuberculosis has frequently been insisted upon, indeed, a good deal more stress has been laid upon this point than upon the desirability of increasing the protein. As a matter of interest, we would point out that the way in which the increase in energy-giving food is usually made, viz., by the addition of milk, means that a considerable increase is at the same time made in the amount of protein.

In a large majority of cases of tuberculosis, it is undoubtedly desirable to increase the amount of energy-giving foods, especially so in the case of patients who have much fever or who are considerably below their proper body-weight. Fat is a less bulky form of energy-giving food than carbo-hydrate, and for this reason is much more readily taken; a patient with anorexia will take a considerable amount more nourishment in the form of fat than in the form of carbo-hydrate. Fat, then, is rightly recognized as a very valuable item in diets for the tubercular. Fat, also, by experimental observations, we have found to be extremely well absorbed, even by patients with high fever and acute constitutional symptoms; for example, 96·4 per cent was absorbed by a patient who took 231 grammes of fat daily. An increase of energy-giving foods beyond a certain point is prejudicial, just in the same way as an increase of protein beyond a certain point does harm rather than good. The taking of an excessive amount of fat and carbo-hydrate results in the putting on of too much body-weight, largely in the form of fat, a condition which is associated with dyspnœa, flabbiness, poor general muscular tone, and often anorexia and dyspepsia.

It is difficult to state the amount of the increase which should be made in fat and carbo-hydrate, as this depends a great deal upon the amount of physical exercise which the patient is allowed to take, as well as upon the other factors which we have previously referred to. On an average, the tubercular patient at physiological rest, viz., not engaged in actual muscular exertion, appears to do best upon a diet which represents an increase of 30 per cent in total calorie value upon his physiological diet. On diets of such a value, and assuming that the protein value has been increased 150 grammes, our patients have regained lost weight at the rate of from 1–2 lb. a week until they are a few pounds in excess of their normal body-weights, a condition which is usually associated with all-round satisfactory progress. In the case of tubercular patients who have quiescent lesions and are restored in general health, and who may be engaged in actual manual work, a still larger amount of energy-giving food will be required; for example, to patients with arrested pulmonary tuberculosis engaged in heavy gardening work such as digging, we prescribe diets with a calorie value, up to 4,500 grammes, with most satisfactory results. A very fair and "rough and ready" guide, as to whether a patient is taking a proper amount of energy-giving food, is given us by his weight. A steady gain of weight of from 1–2 lb. a week in the case of a patient with active disease who is considerably below his weight is satisfactory. A steady increase of body-weight in the case of a patient already some pounds in excess of what is deemed his normal body-weight, is an indication that he is taking too much energy-giving food, or not taking sufficient exercise. Our practice is to make a reduction of 15 per cent in the energy-giving foods when a patient has reached a body-weight slightly in excess of his normal.

To summarize, then, the general principles for the dieting of the tuberculous are as follows :—

1. The amount of protein in the physiological diet should be increased by 30 per cent, and this increase should be maintained until the disease is obsolete.

2. If the patient is under weight, the physiological diet should also be increased 30 per cent in the purely energy-giving foods, viz., either in fats or carbo-hydrates, or partly in each. This increase should be maintained until the weight becomes stationary at a point a few pounds in excess of the patient's highest known weight before becoming infected with tuberculosis.

A decrease of 15 per cent may then be made, and the diet, thus altered, should be continued until the disease is obsolete.

Individual and class habits will determine the relative amounts of fat and carbo-hydrate prescribed.

(3) Patients with constitutional disturbance associated with anorexia or dyspepsia usually require a somewhat concentrated diet, so as to give the comparatively large amount of nourishment in a but slightly increased bulk of food-stuffs.

(4) The meals should be well cooked, varied, and given as far as possible at considerable intervals, and reliance should be placed upon plain food-stuffs whenever possible ; invalid food should only be used when ordinary foods cannot be taken.

THE STANDARD DIET

To arrive at a standard diet suitable for the treatment of the average adult suffering from tuberculosis, we have worked out the average nutritive value of the diets taken by 200 of our patients who made very satisfactory recoveries. We have, in this analysis, considered the diets taken by the men and women patients separately, and from them we have calculated the standard diet for each sex respectively. The 200 patients by whom these diets were taken, as has previously been mentioned, represented many types of tubercular disease both as regards the exact nature of, the extent of, and the severity of the morbid process. The nutritive value of the average diet taken by the men patients works out at approximately 150 grammes of protein and 3,200 calories daily, the average diet taken by the women at 128 grammes of protein and 2,700 calories. These are standard working diets, and as such will be found very useful, and to give very satisfactory clinical results. They will, of course, require modification in individual cases; for example, a man of large physique will require quite 10 per cent more protein and 20 per cent more calorie value than a small man, other things being equal. As a matter of experience, however, we do not often prescribe to patients with active tuberculosis diets with a lower nutritive value than those of our standard dietary.

It is of interest to compare our standard diets with the standard diet worked out by a careful observer on this subject, Dr. H. M. King of the Loomis Sanatorium in America. In his paper, "Diets in Tuberculosis" published in the *Transactions* of the National Association for the Study and Prevention of Tuberculosis (Washington, 1906), Dr. King thus describes his observations:

"With a view of establishing a working diet, so to speak, for certain classes of tubercular invalids the following experiment was recently made at the annex of the Loomis Sanatorium. Twelve patients equally divided as to sex were selected with reference—first, to similarity of conditions, all but one with quiescent or arrested lesions, and that one with but a very moderately active lesion; secondly, with reference to similarity of weight, the men averaging 11 or 12 kilos more than the women; and thirdly, with reference to a close approach of each patient to his or her normal weight. In all but one case the patients were but slightly below the indicated standard; nevertheless, the appearance was that of a very well-nourished group of individuals. These patients were placed at a table by themselves, and their food, while not differing from that of the other patients, either in quality or quantity, was accurately weighed and recorded for a period of 14 days. The average diet taken by these patients throughout this period worked out at 166 grammes protein, 179 grammes fat, 322 grammes carbo-hydrate, with a calorie value of 3,667."

Commenting on this average diet, Dr. King states that "This dietary has seemed to us to meet in a fairly satisfactory manner the requirements of the class of tuberculous invalids treated in the annex division of the Loomis Sanatorium. Nevertheless, I felt that the protein constituent of the dietary has been in excess of the tissue needs, and if so, that an unnecessary and perhaps harmful tax was thus imposed upon the organs concerned in protein metabolism and elimination."

The diet taken by King's patients at the Loomis Sanatorium is somewhat larger than our standard diet for men, both in protein and calorie value, the average daily intake of protein in King's diet being 166 grammes compared with 150 grammes in our standard diet.

	Grams. of Protein.	Cals.
King's standard diet	166	3,667
Our standard diet for men . . .	150	3,200

In a letter to us on the subject, King writes: "The question of establishing the minimum protein food constituent which would give a plus nitrogen balance in cases of tuberculosis is of much interest to me, and I have not by any means reached satisfactory conclusions with regard to it. For the present, the average diet which we find, for practical purposes, most useful, is almost identical with that which you quote as having been found most satisfactory with you, except that we probably average a greater consumption of carbo-hydrates, bringing the total calories to from 3,000 to 3,700."

ON THE TREATMENT OF TUBERCULOSIS WITH VERY LARGE DIETS, OFTEN SPOKEN OF AS FORCED FEEDING

The treatment of tuberculosis, especially of pulmonary tuberculosis, with very large diets has been so frequently advocated, and is still so widely practised, that it is necessary to refer to it.

The routine treatment of consumption with diets of a very high nutritive value is very often associated with most satisfactory clinical results, as evidenced by arrest of the tubercular process and restoration of health and strength, although this method of treatment results in a considerable strain being thrown upon the digestive system and the body metabolism. In the case of patients who have good constitutions, and especially good digestions, continued high feeding may produce no permanent and indeed little or no temporary ill-effects, except some dyspnœa due to excess of body-weight. Such a patient becomes obviously too fat, often a stone or two above his normal weight, but his digestive and excretory organs may successfully cope with the strain imposed upon them. On return to ordinary life, on completion of his course of treatment, such a patient loses a good deal of his excess weight, and the net result may be satisfactory enough. In many instances, however, and notably in the case of patients with naturally weak digestions and in those who continue the high feeding for a long time after their normal body-weight has been well exceeded, the taking of a very large diet is attended with very serious disadvantages. One of the earliest symptoms is failure of appetite, amounting to a positive loathing of food; very often also there is flatulent dyspepsia.

This impairment of the alimentary system is often associated on exertion with a degree of dyspnœa out of all proportion to the extent of the lung disease; this dyspnœa is no doubt due to the loss of the physiological balance between the cardio-respiratory functions and body-weight. An individual in such a condition looks obviously too fat, and not infrequently, in addition to some degree of anorexia and flatulent dyspepsia, he complains of a feeling of heaviness throughout the day, but especially marked after meals, and a general inaptitude for physical and mental exertion. If the administration of very large diets be continued after the condition just described has been established, vomiting and diarrhœa may follow, representing, as Sir Douglas Powell suggests, "the attempts of nature to rectify our want of foresight." The result is that the individual, for a time at least, takes a smaller diet and loses some weight, and his alimentary tract benefiting from this rest usually soon recovers its normal tone. It is to be said in favour of the system of continued very high feeding that, in spite of the discomforts and digestive disorders from which many patients suffer when thus treated, it often results in the tubercular disease becoming arrested. Excessive feeding is clearly a vastly better method of treatment than under-feeding, for it at least ensures the patient taking enough to repair his waste. The point to realize is that such over-feeding is quite an unnecessary hardship for a patient to undergo, and that it may do positive harm.

ON THE CONSTRUCTION OF DIETS HAVING THE SAME NUTRITIVE VALUE AS OUR STANDARD DIETS

The diet prescribed to patients suffering from tuberculosis should contain the food-stuffs generally used by people in ordinary life. To construct any dietary of a certain definite nutritive value it is necessary to have a knowledge of the percentage composition of the various food-stuffs contained in it.

The following table gives the approximate nutritive values of the food-stuffs commonly used and will be found of considerable practical value. The analyses of the uncooked foods are taken from Attwater's tables. The nutritive value of the cooked foods mentioned in the table we have ourselves determined by a series of analyses.

Approximate Nutritive Value per Ounce of Food-stuffs.	P. Grammes.	F. Grammes.	C.H. Grammes.
Beef, roasted as served	7	2	—
Mutton, game, chicken, etc.	6	1	—
Boiled fish	4·5	1	—
Raw meat, scraped	4	Trace	—
Milk puddings, blancmange, custard, etc.	1·2	1·2	4
Boiled suet puddings	1·7	3·6	14·2
Boiled potatoes	0·6	—	6
Eggs	6	4	—
Bread and cake	2·3	—	14
Butter, dripping, margarine, etc.	—	22	—
Milk (per oz.)	1	1·2	1·5
Benger's food (made entirely with milk)	1·2	1·2	3·4

Milk.—Milk is a very valuable food-stuff, since by its use a considerable amount of nourishment can be prescribed in a very easily-taken form. The inclusion of 3 pints of milk in a patient's dietary means that a third of the necessary protein and calorie value is thus given. Milk, however, is not an essential constituent of the diet, especially in the treatment of patients who have normal digestions and can take solid foods. When, on grounds of economy, milk is not advantageously included in the diet, the patient does perfectly well, so long, of course, as the nutritive value of his diet is kept up to the requisite standard.

When whole milk cannot be afforded, use should very often be made of skimmed, or separated, milk.

It must be admitted that whole milk is much more palatable than separated (or skimmed) milk, but, at the same time, separated milk, as a drink, is by no means so unpalatable as to contra-indicate its use. The main use, however, for which we recommend separated milk is in cooking.

In puddings it is almost impossible to distinguish those made with whole milk from those made with separated milk.

Again, separated milk can be used advantageously in making cocoa, oatmeal porridge, and, in general, most articles which require milk.

It may be said that the use of separated milk, which is confessedly of lower nutritive value, bulk for bulk, than whole milk, lowers the nutritive value of the diet. This is, of course, quite true, but it is of little or no importance to the healthy man, who can make up the deficiency easily enough in other ways. In the case of persons with poor appetites, the fat lost by separation can readily enough be restored by the use of an equivalent amount of margarine, which, for cooking purposes, is quite as satisfactory as butter and less expensive. A gallon of whole milk loses 168 grammes of fat by the process of separation, and this 168 grammes of fat costs 8*d*. One hundred and sixty-eight grammes of fat, in the form of the best margarine, costs about 3*d*. In other words, we save 5*d*. per gallon if we use separated milk and margarine in place of whole milk without affecting either the nutritive value in the slightest degree or the palatability, provided the materials are used for cooking only.

These economic properties of milk, though not generally made use of, appear to us to be worthy of the consideration of those responsible for the construction of dietaries for the poor.

Meat.—Meat should always be included in the dietary as one of the chief sources of protein. Meat, also is not an essential, when treating patients with normal appetites and digestions; we have obtained excellent clinical results when treating tubercular patients upon entirely meat-free diets, in which the protein was given in milk and vegetable foods. These meat-free diets, though very cheap, are difficult to make really palatable and, in the long run, it is better economy to include a certain amount of meat.

The amount of meat included in the average standard dietary should be quite reasonable, viz., from 9–12 oz. of meat, as purchased daily. An ill-balanced diet containing a large excess of meat, is as prejudicial to the tubercular as to the normal individual. In some cases with marked dyspepsia or high fever, and also in tuberculous enteritis, we have found raw meat to be very beneficial; this may be, in part, accounted for by raw meat being very easily, and completely, absorbed by the alimentary canal.

When prescribing raw meat, there is some risk, however, of introducing parasites.

Cod-liver oil, etc.—Cod-liver oil, malt and oil, etc., are to be considered more in the light of food-stuffs than of drugs. They have a very distinct value, especially in private practice, as the amount of fat given daily can be readily increased by prescribing them as a medicine to be taken with meals. It is quite possible that these oils have a beneficial effect, quite apart from their food value, but this point is uncertain.

In sanatorium practice they are but rarely used, as fat can be given in adequate amounts in more palatable ways, for instance, in butter and milk. Oils are very valuable indeed in the dieting of tuberculous children, as they are readily taken by them. In the case of out-patients, also, they are a very useful means of increasing the value of the diet.

Alcohol.—There is a considerable difference of opinion as to the value of alcohol in the dietetic treatment of tuberculosis.

We do not advise the inclusion of alcohol in a routine diet for a sanatorium for tubercular patients or as a regular constituent of a tubercular dietary. Alcohol, however, is often of use; in patients with considerable debility, a glass of Burgundy, or some good wine with luncheon and dinner, often improves the appetite and digestion of such patients; in the case, too, of people who have always been used to a certain amount of alcohol, it is sometimes advisable to allow small amounts to be taken at the usual times. A glass of beer at meals in place of milk can often be given to convalescent patients with advantage. Alcohol is often of great service in treating patients who are acutely ill, or considerably exhausted; brandy, in doses of 1–3 oz. daily, in our experience is the most satisfactory form in which to prescribe it. In the treatment of night sweats, also, ½–1½ oz. of brandy, given in hot milk, often gives great relief, and not infrequently, the taking of such a draught in the early hours of the morning will altogether prevent the occurrence of this depressing symptom.

DIETS FOR THE LEISURED CLASSES

The diets prescribed to people suffering from tuberculosis should be as far as possible similar to those taken by the same individuals when in ordinary health; the nutritive value, however, must be somewhat larger—on an average, some 150 grammes protein and 3,200 calories daily. An examination of the diets usually taken by the leisured classes shows us that their average intake of 120 grammes of protein daily is taken approximately in the following way: in meat and fish, 60 per cent, in dairy produce, such as milk and eggs, 16 per cent, the remaining 24 per cent. being taken as vegetable protein, for instance, in bread, potatoes, etc. Energy is mostly taken in the form of bread, cakes, pastry, etc., butter, puddings of various sorts (which contain milk, suet, eggs and butter in their composition), bacon, and, to a less extent, in fruit, vegetables, jams, marmalade, sugar, etc. Approximately speaking, the proportion of fat to carbo-hydrate in the ordinary diet of the leisured classes is 3 parts of fat to 5 parts of carbo-hydrate. It will be remembered that fat is a more expensive, but a more palatable and less bulky form of energy-giving food than carbo-hydrate; this fact explains the preference of the leisured classes for fat as a source of energy.

When constructing dietaries for use by tubercular patients of the leisured classes, the increase of 30 per cent of protein and calorie value is best made by adding to an average normal dietary the requisite amount of food-stuffs of a similar nature to those which are already included in the dietary. Supposing that on inquiry we find that any particular patient's diet when in normal health has been adequate from a nutritive standpoint, an addition of 3 pints of milk daily will often be sufficient to bring this dietary up to the necessary nutritive standard for the efficient treatment of tuberculosis. Three pints of milk means an addition to the dietary of

Protein.	Fat.	Carbo-hydrates.	Calories.
50	60	75	1,070

In short, of one-third of the diet necessary.

It must not be forgotten, however, in this respect, that the diets of patients when they are first found to be tubercular are often inadequate, the patient having unconsciously materially reduced his dietary in consequence of gradually increasing anorexia. The diet, then, of any patient when he first comes under observation very often does not represent the individual's ordinary diet when in normal health. This construction of a diet for the tubercular by the addition of 3 pints of milk to an individual's ordinary diet when in health is a very simple method and is often satisfactory; in actual practice, however, many people find some difficulty in taking an extra 3 pints of milk in addition to the milk they are already taking in tea, coffee, puddings, etc. The extra milk may be taken, a pint at each meal, or half a pint may be taken at each meal, the other three half-pints being taken at other times—preferably, perhaps, on waking, in the middle of the morning, and in the middle of the afternoon, or the last thing at night. The majority of people prefer the latter method, viz., taking the milk in half-pints distributed over the day, but, in our experience, the one method is quite as satisfactory as the other from a clinical standpoint. A certain number of people are unable to take milk in its natural form on account of dyspepsia and other alimentary disturbances which it gives rise to; in some of these cases, the symptoms appear to be due to a real dyspepsia; in others, and more often in people of a nervous temperament, the difficulty appears to be simply an idiosyncrasy. It is very rarely, however, that milk cannot be satisfactorily taken by these patients if its taste be disguised somewhat. The best methods of altering the milk are as follows: (1) by the addition to it of a small quantity of very strong tea or coffee; (2) by making it into a rather fluid Benger's food preparation; (3) by having it completely or partially pancreatized; (4) by flavouring the milk with bovril, in the proportion of a teaspoonful of bovril to a half a pint of milk; this last method results in a richly flavoured and very nutritive beef-tea, from which the taste of milk is absent. A certain amount of milk can be given in the shape of junket, custard, egg-flip, etc., but these preparations are only subsidiary, and must not be relied upon as the chief means of prescribing milk.

The value of milk, as a constituent of diets for the tubercular has long been recognized, and many people think that a dietary for a consumptive cannot be adequate and efficient if milk is not included in it. This, as already explained, is a fallacy. Milk, in short, has no specific value from a clinical standpoint.

Detailed description of diets for the leisured classes.—The following dietary has the nutritive value of our standard diet for the treatment of the average tubercular man, viz., protein 155, calorie value, 3,250.

	Protein.	Fat.	Carbo-hydrate.
	Grms.	Grms.	Grms.
Milk, 3 pints	57	70	87
Bread, 6 oz.	16	2	88
Butter, 1½ oz.	—	32	—
Cream, 1 oz.	1	6	—
Fish, 4 oz.	20	10	—
Meat, 6 oz.	44	22	—
Milk pudding, 4 oz. / Suet or sponge pudding, 3 oz.	9	16	50
Potatoes, 5 oz.	1	—	30
Egg, 1	6	4	—
Stewed fruit, green vegetables, soups, etc., from time to time, q.s.	1	1	7
Cake, 1 oz.	1	2	12
Totals	155	160	275

Total calorie value 3,250.

In the above table the nutritive values of the majority of the food-stuffs have been calculated from the tables of the percentage composition of food-stuffs of Attwater, and in the case of the food-stuffs from original analyses.

In practice this dietary may conveniently be given in the following way :—

Man.		Woman.
	BREAKFAST.	
Two breakfast cups.	Milk (usually flavoured with coffee).	Two breakfast cups.
Four ordinary-sized "triangles."	Toast (or bread).	Three ordinary-sized "triangles."
A piece the size of a walnut.	Butter.	A piece the size of a walnut.
One egg.	Egg.	One egg.
An ordinary sized helping.	Bacon, cold ham, tongue, a herring, or a fillet of fish, etc., etc.	An ordinary sized helping.
Four tablespoonfuls.	*Porridge (in place of half the bread) and milk or cream.*	Three tablespoonfuls.
	11 A.M.	
A tumblerful.	Milk.	A tumblerful.

Man.		Woman.
	LUNCH.	
A tumblerful.	Milk.	A tumblerful.
An ordinary sized helping.	Fish or *entrée.*	An ordinary sized helping.
2½ oz. (a large helping).	Meat.	2 oz. (a large helping).
Two, the size of a hen's egg.	Potatoes.	Two, the size of a hen's egg.
According to taste.	*Green vegetables.*	According to taste.
Half a round (thick).	Bread.	Half a round (thick).
A piece the size of a walnut.	Butter.	A piece the size of a walnut.
A large helping (4 or 5 oz.).	Milk or other pudding, stewed fruit and custard or creams, etc.	A large helping (3 or 4 oz.).
Tea, a slice of thin bread and butter and a piece of cake, pastry, etc.	TEA.	*Tea, a slice of thin bread and butter and a piece of cake, pastry, etc.*
	DINNER.	
A tumblerful.	Milk.	A tumblerful.
If desired.	*Soup.*	If desired.
An ordinary helping.	Fish or *entrée.*	An ordinary helping.
As at lunch.	Meat. Potatoes and vegetables. Pudding, etc.	As at lunch.
Half a round.	Bread or toast.	Half a round.
A piece the size of a walnut	Butter.	A piece the size of a walnut
If desired.	*Savoury or cheese, etc. Dessert.*	If desired.
	AT BEDTIME.	
A tumblerful.	Milk.	A tumblerful.

N.B.—The essential food-stuffs in the above dietary are printed in Roman letters; those which may be left to the discretion of the patient in italics.

Approximate value of the above diets :—

Men	155 protein	160 fat	275 carbo-hydrate.
Women . . .	135 protein	140 fat	230 carbo-hydrate.

If the above diets are compared with those taken by people in ordinary health, it is seen that there is no great difference between them, the additional milk, perhaps, being the principal feature. It is essential, of course, that these diets be varied and well cooked.

When varying the puddings, it must be remembered that they should always be made of highly nutritive food-stuffs. Fruit should be given at least three times a week in the form of stewed fruit, tarts, etc.; vegetables, also, are an important item in the diet; and a fair amount of potatoes and greens should be given at each meat meal; beans and peas and, to a less extent, carrots and parsnips, are also of great value.

The diet can be conveniently reduced in amount, when required, by reducing the amount of milk to 1 pint daily.

There are a very large number of people—what one may perhaps term the lower middle classes—who take a large midday meal and a meat tea followed by a light supper in place of the luncheon and dinner of the more well-to-do classes. Others, again, are in the habit of taking a fairly substantial sit-down tea (without meat) and also a substantial supper. To people who are accustomed to meals of this kind we can recommend the following diets:—

Men.		Women.
	BREAKFAST.	
A soup-plateful.	Porridge (oatmeal, rolled oats, etc.), sugar and cream.	Four tablespoonfuls.
One pint.	Milk.	One pint.
½ oz. A piece the size of a walnut.	Butter.	½ oz. A piece the size of a walnut.
Three triangles of toast or a round and a half of bread.	Bread or toast.	Two triangles of toast or a round of bread.
An ordinary helping.	Egg, bacon or sausage, etc.	An ordinary helping.
	DINNER.	
4 oz. (a large helping).	Meat (hot or cold).	3 oz. (a large plateful).
5 oz. (four the size of an egg).	Potatoes.	3 oz. (two the size of a hen's egg).
As desired.	*Green vegetables.*	As desired.
5 oz. (a large helping).	Milk or suet pudding.	4 oz. (a large helping).
1 pint.	Milk.	1 pint.
1½ oz. (half a round).	Bread.	1 oz. (half a round).
½ oz. (a piece the size of a walnut).	Butter.	½ oz. (a piece the size of a walnut).

Man.		Woman.
	TEA.	
Three slices thin bread and butter.	Bread. Butter. *Jam, cake, cress, etc.*	Two slices thin bread and butter.
	SUPPER.	
3 oz. (a large helping).	Cold meat, boiled ham, tongue, fillets of fish, brawn, sausage, macaroni, cheese, etc., etc.	2½ oz. (a large helping).
5 oz. (a fair-sized helping).	Cold sweet such as cream, blancmange, fruit and custard, trifle, etc.	4 oz. (a fair-sized helping).
1 pint.	Milk (possibly made into cocoa).	1 pint.
2 oz. (half a round, thick).	Bread or biscuit (with cheese if preferred).	1½ oz. (half a round).
½ oz. (piece the size of a walnut).	Butter.	½ oz. (a piece the size of a walnut).

The above dietary has the following nutritive value :—

Men	156 protein	168 fat	283 carbo-hydrate calorie value.
Women . . .	130 protein	145 fat	235 carbo-hydrate calorie value.

In the above table the essential articles are printed in Roman type, and the non-essentials in italics.

DIETS FOR THE WORKING CLASSES

When prescribing diets for the working classes, we have to bear in mind the following important points : (1) the diet, in its general lines of construction, must be similar to the meals which the poorer classes habitually take ; for instance, it must contain considerably more carbo-hydrates than fat, roughly in the proportion of 5 parts of carbo-hydrate to 1 of fat. (2) The diet must be cheap, generally speaking, not costing more than one shilling a day.

Principles of construction of the average working class diet.—The general lines of construction of dietaries taken by the working classes are well shown in the following table. This table represents an analysis which we have made of 100 efficient diets taken by working class families. The average nutritive value of these 100 diets works out at protein 127 grammes, fat 114 grammes, and carbo-hydrate 417 grammes, giving a calorie value of 3,290, the average cost, excluding a small amount spent on beer, being 10*d.* a day.

Table showing the Average of 100 Efficient Dietaries taken by Working-Class Families.

Food-Stuffs.	Amount	Grammes.	Price (retail).	Cost in Pence.	Protein.	Fat.	Carbo-hydrate.
Milk .	½ pt.	280	@ 1½*d.* per pt.	0·75	10	11	14
Meat[1] .	9 oz.	250	@ 7*d.* per lb.	3·93	38	48	—
Butter .	⅔ oz.	20	@ 1*s.* per lb.	0·50	—	16	—
Fish. .	2 oz.	56	@ 4*d.* per lb.	0·50	5	1	—
Cheese .	½ oz.	14	@ 6*d.* per lb.	0·20	4	5	—
Egg. .	one	one	@ 3 for 2*d.*	0·66	6	4	—
Bacon .	2 oz.	56	@ 6*d.* per lb.	0·75	6	24	—
Total animal food				7·29	69	109	14
Bread[2].	14 oz.	400	@ 2½*d.* per 2 lb.	1·14	36	4	200
Flour .	1 oz.	28	@ 1*s.* 4*d.* per st.	0·08	3	—	21
Oatmeal	½ oz.	14	@ 2*d.* per lb.	0·07	2	1	10
Potatoes	9 oz.	250	@ 8*d.* per st.	0·32	4	—	52
Sugar .	3 oz.	85	@ 3½*d.* per lb.	0·70	—	—	85
Rice, etc.	⅜ oz.	10	@ 2½*d.* per lb.	0·03	—	—	6
Sundries, vegetables, etc.[3]				0·43	6	—	20
				2·77	51	5	394
Beverages and unnecessary articles of low nutritive value				0·75	7	—	9
Totals				10·81	127	114	417

As shown by the above analysis, the average working man takes some 33 per cent of his protein in the shape of meat and fish (as compared with 60 per cent taken by the leisured classes in the same food-stuffs), 20 per cent in the form of dairy produce,

[1] Includes beef, mutton, pork, liver, sausage, etc.
[2] Includes cakes and buns.
[3] Includes green vegetables, onions, tomatoes, currants, etc.; fruit, tea, coffee, condiments, etc.

30 per cent in the shape of bread, and 17 per cent in other vegetable forms.

The average working man's diet is a distinctly bulky one owing to the large amount of carbo-hydrate it contains. It is perhaps worth mentioning that we once prescribed a thoroughly adequate dietary, such as we would give to the leisured classes, to some working class patients, and they told us it did not satisfy their hunger. The very high nutritive value of the diet prescribed made it clear that it was perfectly adequate from a nutritive standpoint, and further observation showed us that it was lack of bulk wherein lay the fault. Apparently, in the case of many of the healthy working classes, a diet of considerable bulk, in addition to an adequate nutritive value, is necessary to satisfy hunger.

The exact construction of a diet for use by the working classes depends upon the amount of money available for food. In most working class families when the bread winner has full work, from five to eight shillings are usually available for the purchase of food per week for each adult of the family. When a patient can afford a shilling a day for his food his diet can be very closely modelled on the average diet shown in our analysis of diets taken by the working classes when in health.

The necessary increase of 30 grammes of protein can be conveniently given either as :—

(1) New milk, 2 pints ; this will cost 3*d.* or 4*d.* per day.

(2) Meat ; this will cost 3*d.* or 4*d.* per day according to the kind of meat used.

(3) Pulse food, 4 oz. ; this will cost ½*d.* per day.

(4) Pulse food, 3 oz. with $\begin{cases} \text{½ pint new milk or} \\ \text{½ pint separated milk ;} \end{cases}$
this will cost 2*d.* per day, or less.

Of these various methods of increasing the protein, the giving of pulse and milk is perhaps the most economical and satisfactory, and the actual diet prescribed to the patient can thus be bought for a shilling a day.

The following diets, which have the requisite nutritive value and which can be bought for a shilling a day, we have found to be most satisfactory.

Men.		Women.
	BREAKFAST.	
Soup-plateful.	Porridge (sugar and milk).	Four tablespoonfuls.
1½ oz. (ordinary helping).	Bacon (cooked) or egg.	1½ oz. (an ordinary helping).
5 oz. for tea and porridge.	Milk.	5 oz. for tea and porridge.
3 oz. (a round).	Bread.	2 oz. (half a round, thick).
¼ oz.	Butter.	
	DINNER.	
5 oz. (=9 oz. as purchased) (a large plateful).	Meat (cooked).	4 oz. (a large helping).
5 oz. (four the size of an egg).	Potatoes.	3 oz. (two the size of an egg).
	Green vegetables.	
5 oz. (a large helping).	Suet pudding.	A large helping.
½ pint.	Milk.	½ pint.
	TEA.	
6 oz. (two thick rounds).	Bread, cake, etc.	4 oz. (a round and a quarter).
1 or 2 oz. (a tablespoonful).	Jam.	1 or 2 oz.
½ oz. (a piece the size of a walnut).	Butter.	½ oz. (a piece the size of a walnut).
	SUPPER.	
Soup-plateful.	Pulse soup, or	Soup-plateful.
2 oz.	Sausage, ham or cold meat.	2 oz.
Soup-plateful.	Or oatmeal porridge and milk and cheese, 2 oz.	Soup-plateful.
5 oz.	Milk or light pudding.	4 oz.
2 oz. (half a round).	Bread.	2 oz. (half a round).
¼ oz.	Butter.	¼ oz.

These diets have the following approximate nutritive values.

Men	P. 156	F. 120	C.H. 468	Cals. 3,674
Women . . .	P. 130	F. 100	C.H. 380	Cals. 3,021

The cost of the above diets works out at about 1*s.* 1*d.* a day for men, and a little less for women.

Cheaper diets for the working classes.—When the amount of money available for the purchase of food is below 7*s.* per week, cheaper diets than those just described must be given, it being absolutely essential that a diet prescribed for a patient should be compatible with his means.

Our standard working class diet can be reduced in cost in various ways without impairing its nutritive value, viz. :—

(1) By reducing the amount of whole milk, and replacing it either in part or entirely by separated milk.

(2) By using the cheaper forms of meat.

(3) By increasing the amount of bread or pulses.

(4) By the substitution of margarine for butter.

In the following table we give, in parallel column, details of four dietaries, all of which are adequate in nutritive value, for the efficient treatment of tuberculosis, and the cost of which varies from 4*s*. 6*d*. to 7*s*. per week.

The palatability and variety of these diets vary directly with their cost; the cheapest of these diets, costing 7·7*d*. per day, can be made quite sufficiently palatable with a little care. It is scarcely possible to prescribe a really adequate diet which will cost less than 4*s*. 6*d*. per week; to be efficient, such a diet would have to contain a very large amount of vegetable protein, viz., pulses, etc., and to make such a diet palatable requires very careful, almost skilled, cooking.

Diet 1 on our table we know by experience to be in every way satisfactory. The amount allowed for the purchase of the several items of food allows of a considerable variation being made from time to time in the diet. Thus, purchasing meat at an average price of 7*d*. per pound allows of the inclusion of every joint of foreign beef at 7½*d*. per pound, Canterbury lamb or mutton at 7*d*. per pound, meat for meat puddings at 4*d*. or 5*d*. per pound, and of liver, kidney, sausage, etc. Findon haddock, cod, etc., and especially tinned salmon, to which the working classes are particularly partial, may also be included in the list of food-stuffs from which selection can be made. The composition of this diet also allows for a suet or milk pudding every day. It will be noticed that a pint of milk and an ounce of butter are also included.

The prices of the various food-stuffs from which the total cost of this diet (11·74*d*. per day) has been calculated are those at which we have actually bought the various articles at ordinary shops and in retail amounts.

In Diet 2, which costs 10·18*d*. per day, economy has been effected by giving only half a pint of whole milk and replacing

TABLE SHOWING THE COMPOSITION OF DIETS SUITABLE FOR THE TREATMENT OF CONSUMPTION, AT A COST OF 4*s.* 6*d.*, 5*s.* 4*d.*, 6*s.*, AND 7*s.* RESPECTIVELY.

		1		2		3		4	
		Oz.	Price.	Oz.	Price.	Oz.	Price.	Oz.	Price.
Composition.	Whole milk	20	@ 2*d.* per pt.	10	@ 2*d.* per pt.	—	—	—	—
	Separated milk	—	—	10	@ 1*d.* per pt.	20	@ 1*d.* per pt.	5	@ 1*d.* per pt.
	Meat, etc. (as purchased)	9	@ 7*d.* per lb.	9	@ 6*d.* per lb.	9	@ 5*d.* per lb.	6	
	Butter	1	@ 1*s.* per lb.	—	—	—	—	—	—
	Margarine	—	—	1	@ 8*d.* per lb.	1	@ 8*d.* per lb.	1	@ 6*d.* per lb.
	Suet	½	—	½	—	½	—	—	—
	Cheese	2	(American) @ 7*d.*	2	(Dutch) @ 5*d.*	2	(Dutch) @ 5*d.*	3	(Dutch) @ 5*d.*
	Bacon and brawn	2	@ 6*d.* per lb.	2	@ 6*d.* per lb.	2	@ 6*d.* per lb.	2	@ 6*d.* per lb.
	Bread	12	—	12	—	12	—	16	—
	Potatoes	8	—	8	—	8	—	8	—
	Pulses	3	—	3	—	3	—	4	—
	Oatmeal	2	—	2	—	2	—	2	—
	Sugar	2	—	2	—	2	—	2	—
	Jam	1	—	1	—	1	—	1	—
	Rice, etc.	½	—	½	—	½	—	—	—
	Flour	1	—	1	—	1	—	—	—
	Green vegetables / Sundries	Sufficient amounts	—	Sufficient amounts	—	Sufficient amounts	—	Sufficient amounts	—
Nutritive value.	Protein (grammes)	—	156	—	158	—	158	—	151
	Fat (grammes)	—	141	—	121	—	110	—	94
	Carbo-hydrate	—	432	—	432	—	432	—	459
	Calories	—	3,722	—	3,545	—	3,452	—	3,375
Economic Efficiency	No. of grammes of Protein bought per penny spent	—	13·3	—	15·5	—	17·3	—	19·5
	No. of calories do.	—	318	—	348	—	374	—	437
	Ratio of costs of animal and vegetable foods	—	72·5 : 27·5	—	68·3 : 31·7	—	64·6 : 35·4	—	54·7 : 45·3
	Cost per diem	—	11·74*d.*	—	10·18*d.*	—	9·12*d.*	—	7·72*d.*
	Cost per week	—	7*s.*	—	6*s.*	—	5*s.* 4*d.*	—	4*s.* 6*d.*

the other half-pint by separated milk. The ounce of butter at 1*s.* per pound is replaced by 1 oz. of margarine at 8*d.* per pound, and 6*d.* per pound is allowed for meat instead of 7*d.* This means that, for the most part, the cheaper forms of meat will have to be bought.

In Diet 3, which costs 9·12*d.* per day, no whole milk is included, a pint of separated milk being used instead, and only 5*d.* per pound is allowed for meat.

Still further economy, as shown by the fourth diet at a cost of 7·7*d.* per day, is obtained by reducing the amount of separated milk to 5 oz. per day, and the amount of meat to 6 oz. per day. As compensation, the daily amount of cheese is increased by 1 oz., the amount of bread by 4 oz., and the amount of pulses by 1 oz. Such a dietary as this will only be necessary when dealing with the very poor.

	Amount.		Price Retail.	Nutritive Value.			Cost.
	Oz.	Grms.		Protein.	Fat.	Car.-Hyd.	Pence.
Separated milk	20	570	@ 8*d.* per gal.	19	1	28	1·00
Meat, etc.	6	170	@ 5*d.* per lb.	31	20	—	1·88
Margarine	1	30	@ 6*d.* per lb.	—	22	—	0·38
Suet	—	—	—	—	—	—	—
Cheese (Dutch)	2	56	@ 5*d.* per lb.	18	11	—	0·63
Egg	—	—	—	—	—	—	—
Bacon	2	56	@ 6*d.* per lb.	4	24	—	0·75
Total animal food				72	78	28	4·64
Bread	16	460	@ 2½*d.* per 2 lb.	41	5	230	1·25
Potatoes	8	230	@ 8*d.* per st.	2	—	32	0·28
Pulses	4	112	@ 2*d.* per lb.	27	2	71	0·50
Oatmeal	2	56	@ 2*d.* per lb.	8	4	37	0·25
Sugar	2	56	@ 2½*d.* per lb.	—	—	56	0·31
Jam	1	28	@ 3½*d.* per lb.	1	—	16	0·22
Rice, etc.	½	14	@ 2½*d.* per lb.	—	—	10	0·08
Flour	—	—	—	—	—	—	—
Green vegetables	—	—	—	5	—	10	0·20
Sundries	—	—	—	—	—	—	0·50
Total vegetable food				84	11	462	3·59
Total food				156	89	490	8·23

Calories bought per penny, 409.
No. of grammes of protein bought per penny, 18·9
Total calorie value, 3,476.
Ratio of cost of animal to vegetable food, 56·3 : 43·7.

The above dietary, which costs just over 8*d.* per day, will also be found adequate for the treatment of tuberculosis.

Diets for use in sanatoria for the working classes, where the patients are employed in various forms of manual labour.—In sanatoria where the convalescent patients are employed in actual manual work, a diet of higher calorie value must be given. After considerable experience, we have adopted the following dietary as our standard for the treatment of this class of patient.

Breakfast.—	Tea.
	Porridge, ½ pt. (=oatmeal, 2 oz.).
	Bacon (cooked), 1½ oz.
	Milk for tea and porridge, 5 oz.
	Loaf sugar, ¾ oz.
	Moist sugar for porridge, 1½ oz.
	Bread, 3 oz.
	Butter, ¼ oz.
Dinner.—	Roast joint, etc., 5 oz.=9 oz. as purchased.
	Potatoes, 5 oz.=8 oz. as purchased.
	Suet pudding, 5 oz.
	Green vegetables, q.s.
Tea.—	Tea.
	Bread, 8 oz. (three rounds).
	Butter, ½ oz.
	Jam, lettuce, etc., q.s.
Supper.—	Pulse soup, ½ pt. (=3 oz. dry pulse).
	Or bread, 3 oz. and cheese, 2 oz.
	Or sausage, liver, fish, ham, etc.
	Milk or cornflour pudding, fruit, etc., 8 oz.
	Cocoa or milk, ½ pint.

Milk may be added if thought desirable in any individual case, but if the whole of the above diet can be taken, milk will be unnecessary.

The protein value of this diet works out at 150 grammes, and the total calorie value at about 4,000.

The use of whole milk and butter, rather than of margarine and separated milk which would make the diet appreciably cheaper, is advised; joints of meat are also given daily. An important feature in this diet is that the extra amount of nourishment required, especially the increase of protein, is given in the cheap form of vegetable protein. This vegetable protein, however, is given in comparatively small amounts and in a palatable form.

The diet, as a whole, is a palatable one, and readily taken by the working classes. From a clinical standpoint, also, we have found it most satisfactory. Its economic efficiency is well shown by the fact that it costs only 6*s.* 8*d.* a week, and for every penny spent 13·2 grammes of protein and 336 calories are bought. This diet should be reduced 15 per cent in its value when prescribed to women patients.

The following is a good weekly menu which can be given when using the diet just described.

WEEK'S MENU.

	Breakfast.	Dinner.	Tea.	Supper.
Sunday . .	Porridge and milk, cold ham, tea, bread and butter.	Roast beef, baked potatoes, boiled peas, fruit tart.	Tea, bread, butter, cake.	Tinned salmon, sponge cake and custard, bread and cheese.
Monday . .	Porridge and milk, fried bacon (rest as above).	Boiled mutton, potatoes and greens, date pudding.	Tea, etc., jam.	Bean soup, macaroni pudding.
Tuesday . .	Porridge and milk, fried bacon.	Cottage pie, suet roll and jam.	Tea, etc., cake.	Fried liver, blanc-mange, stewed fruit.
Wednesday .	Porridge and milk, fried bacon.	Stewed steak and onions, potatoes, boiled ginger pudding.	Tea, etc., lettuce.	Pea soup, boiled rice and jam.
Thursday .	Porridge and milk, cold ham.	Roast mutton, boiled beans, bread pudding.	Tea, bread, butter, and jam.	Sausage or fish, bread and butter pudding.
Friday . .	Porridge and milk, bacon.	Boiled beef and vegetables, potatoes, plum duff.	Tea and cake.	Lentil soup, baked lemon pudding.
Saturday .	Porridge and milk, Findon haddock.	Beef steak and kidney pie, boiled peas, milk pudding.	Tea, etc., jam.	Stewed kidney and macaroni, blanc-mange, stewed fruit.

Directions for poor tubercular patients living at home, for instance, those attending out patients' departments at hospitals, etc.—It is by no means easy efficiently to direct the dietetic treatment of tubercular people belonging to the working classes unless they are immediately under supervision, e.g. in an institution. In our experience, the prescription of a definite diet to consumptive patients among the poorer classes is not satisfactory, as, for the most part, they have not the means at home of carrying out instructions at all accurately.

We have obtained more satisfactory results in such cases after giving general directions, as under:—

"You require to take much more food than you did before you became consumptive. Do not hurry over your meals; you will feel satisfied frequently before you have eaten enough, and you must continue to eat even when you do not want more food. Your appetite is no guide as to the amount you need. The best way to find out whether you are eating enough is to weigh yourself every week, always at the same time of day and in the same clothes. If you have not gained at least one pound during the week, you will know you have not been eating enough.

"**What food to buy and how to cook it.**—The following is intended to give you a rough idea as to how you can arrange your meals most satisfactorily, and the amounts of the various foods you require.

"*Breakfast.*—Half a pint of porridge with milk and sugar, a rasher of bacon or a herring, etc., a round of bread. Tea or coffee.

"*Dinner.*—Two large chops or a large plateful of meat, with plenty of potatoes. A teacupful of milk pudding, or a large slice of suet pudding, half a round of bread, and a glass of milk.

"*Tea.*—At least three rounds of bread and butter with jam, or, if you can afford it, other relish.

"*Supper.*—Half a pint of pea, bean, or lentil soup, or half a pint of porridge; two rounds of bread, with sufficient cheese for both pieces; and a glass of milk.

"If you take this diet, you ought to gain at least a pound a week in weight, but if you do not, your best course is to take more milk until your weight increases.

"The above diet should cost you about 6*s*. 6*d*. per week, but you will require to be careful as to what you buy, and the following notes will probably be of service to you in showing you how to spend your money to the greatest advantage.

"*Meat.*—If you cannot afford to buy English meat, buy the best foreign, which contains just as much nourishment and will not cost you more than 6½*d*. per pound for the best joints. If you cannot afford to buy joints you must be content to buy 'pieces.' Make full use of tripe, sausage, bullock's liver and kidney, which are cheap and nutritious, but do not waste money on veal and lamb.

"*Butter.*—Buy butter at 1*s*. a pound if you can afford it, but if money is scarce buy good margarine instead, at 6*d*. or 8*d*.

"*Milk.*—You can always get new milk at 1½*d*. or 2*d*. per pint, but if you cannot afford to buy much new milk, buy what you can afford and make up with separated milk, which will cost you 1*d*. or 1½*d*. per quart.

"*Cheese.*—Dutch cheese will cost you 4½*d*. to 6½*d*., and American 6*d*. or 7*d*. Do not buy more expensive cheese, as you will get no more nourishment for the extra cost.

"*Eggs.*—Except during the early summer, eggs are always an expensive form of food, therefore do not spend more on them than you can help.

"*Oatmeal.*—Oatmeal is one of the very best and cheapest foods you can have. Buy coarse Scotch oatmeal, Provost or Quaker oats, and have a plateful of porridge every morning and, if you like it, occasionally at supper instead of the soup.

"*Dried peas, beans, and lentils.*—These, like oatmeal, are most valuable foods for you, and should be used every day either boiled as a vegetable for dinner or as a soup for supper. You can buy them at the grocer's; the peas and haricot beans will cost you 2½*d*. per pound or pint, and the lentils 2*d*.

"*Potatoes.*—These are required every day, and you will save money if you buy at least a stone at a time.

"*Fish.*—Buy fish instead of meat occasionally for the sake of a change, either cod, plaice, herrings, bloaters, Findon or fresh haddocks, or whatever fish is in season and cheap. Tinned salmon at 5*d.* a tin is a cheap and nutritious food, and makes a good change for supper.

"The following rough directions for cooking may be of use:—

"*Porridge.*—Stir oatmeal gradually into boiling water, add a pinch of salt, and cook gently, stirring occasionally for an hour (Quaker and Provost oats take only 20 minutes to cook). Allow two teacupsful of water and two level tablespoonsful of oatmeal to each man.

"*Lentil, pea or bean soup.*—Soak the seeds in cold water over night. Boil gently in plenty of water until soft; the cooked seeds may either be eaten as a vegetable, or they may be beaten to a fine paste, or, better still, rubbed through a sieve; add a little of the liquid in which they were boiled, and a flavouring if required, to form a highly nutritious soup. Allow three level tablespoonsful of the raw seeds for each man.

"*Suet puddings.*—(1) Allow one level teaspoonful of dripping, three level tablespoonsful of flour, and a large pinch of baking powder per man. Mix the dripping thoroughly with the flour and baking powder. Make the whole into a paste with a little water, form into a roll, flour the surface, tie up tightly in a pudding cloth, and boil for 2 or 3 hours. Serve with syrup, gravy, or jam.

"(2) Or the above paste may be rolled out flat, and jam or syrup spread upon it. Roll, fold in the ends, flour the surface, tie tightly in a cloth, and boil for 2 or 3 hours.

"(3) Allow one level teaspoonful of dripping, three level tablespoonsful of flour, a large pinch of baking powder, and a little sugar and fruit for each man. The fruit may be either currants, figs, or dates chopped up finely, or raisins. Mix the flour and dripping and sugar, add the fruit and make into a paste with a little water, flour the surface, and tie tightly in a cloth; boil 2 or 3 hours. Instead of the fruit, a little syrup and a pinch of ground ginger may be used in the above mixture.

"*Milk pudding.*—Allow for each person two level teaspoonsful of rice, sago, tapioca, etc., and two-thirds of a pint of milk and a small teaspoonful of sugar. Put the rice, sugar and milk, with a pinch of salt, into a pie-dish, and bake slowly in the oven for 2 or 3 hours."

The above directions have stood the test of experience; they have been given to patients and used by them, the results being carefully tested. The improvement in the state of the lungs and general health, gain in weight, etc., prove them (in most cases we have followed) to be most satisfactory.

CONCENTRATED DIETS

The maintenance of a high level of nutrition is of essential importance for the efficient treatment of tuberculosis, and inability on the part of a patient suffering from this disease to take a fairly generous diet, such as one of our standard dietaries, materially prejudices his chances of recovery. Anorexia is a very common symptom in tubercular patients. In some cases it is of small importance and requires no special treatment. Not infrequently, on the other hand, it requires the most careful dieting.

Anorexia of a very marked character is often met with in patients suffering from early tuberculosis; this anorexia has usually been of gradual onset and associated with progressive loss of strength and weight. The patient is anæmic and obviously run down, and on inquiry is found to be taking a diet altogether inadequate for a person in ordinary health, much less for a person suffering from tuberculosis.

Consumptives suffering from the earlier stages of the disease, especially those living under unfavourable hygienic conditions (for instance a clerk working in a badly ventilated city office), very commonly have this anorexia of early tuberculosis. A certain amount of dyspepsia is sometimes associated with loss of appetite, but examination of the alimentary track shows that the digestive organs are perfectly normal.

The treatment of this type of anorexia consists in placing the patient under good hygienic conditions and giving him a generous diet which he should be strongly encouraged to take, in spite of the absence of appetite. There are few things more striking than the immediate improvement in appetite which follows the removal of a patient suffering from early pulmonary tuberculosis from unfavourable conditions to a sanatorium. If the patient takes the generous diet, as advised, it is seldom that this course of treatment is not completely successful.

Within a week of his arrival the patient usually has entirely regained his normal appetite, and indeed, if urged to do so, will eat enormously, an experience which many a sanatorium patient has unfortunately suffered from.

A much more serious type of anorexia is that very often met with in patients suffering from active tuberculosis associated with pronounced constitutional disturbance, such as high fever, etc. A patient with a considerable amount of fever, whatever be its cause, rarely retains a normal appetite. In a large number of febrile diseases, especially in those running a short course, comparatively speaking, the normal diet of health can be appreciably reduced without disadvantage to the patient. In the case of tuberculosis this cannot be done ; at all costs, the patient's diet must be kept up to a high standard of nutritive value. The same principle holds good for another type of anorexia, commonly met with in tubercular patients, viz., the chronic loss of appetite associated with slowly progressive disease of long duration. Patients who suffer from long standing progressive tuberculosis usually have their constitutions permanently damaged ; vascular and muscular tone are poor, and the alimentary track is generally impaired. This impairment, in our experience, is very largely atonic in character, the most pronounced symptoms being persistent loss of appetite, fulness and abdominal discomfort after meals with nausea and vomiting if large meals are taken. We have been interested to observe that stomach analyses and metabolic investigations in these cases show that digestion and absorption are almost invariably normal.

The dietetic treatment of the anorexia of acute constitutional disturbance, and of the digestive impairment of disease of long standing are very similar. In the case of patients with acute symptoms, such as high fever, etc., it is a good practice to encourage the patient to make an effort to take an ordinary diet, such as one of our standard diets, and to remind him that his illness is likely to be a protracted one and that he must take a good supply of food daily if he wishes to get better.

We have found that many patients with high fever, especially those in whom the infection is of a recent date, and in whom the constitution has not been impaired, take an ordinary diet quite well and with most satisfactory clinical results. Our experience inclines us to think that the patients who manage to take an ordinary diet, for the most part, make more rapid progress. An ordinary diet, however, should not be continued if it gives rise to much dyspepsia, or if the patient, after some ten days' trial of it, takes an inordinate time over his meals. In a similar way, patients suffering from long standing chronic disease and who have marked anorexia and dyspepsia, can sometimes be persuaded to take an ordinary diet and do remarkably well; general health improves, and with this improvement the dyspepsia gradually disappears and appetite returns. Such a happy result is most likely to follow this treatment in the case of such patients who have just given up work and exchanged life in a town for the favourable conditions afforded by residence in a sanatorium. To prescribe generous diets to the same class of patients who are still at work in a city, or who have already enjoyed the advantages of a sanatorium for some time, is much less likely to prove a success. Considerable judgment must be exercised in determining how long to urge the taking of ordinary diets despite the existence of loss of appetite and dyspepsia, both in the case of patients with acute and chronic disease; gradually increasing anorexia and dyspepsia, and especially onset of nausea and vomiting, however, certainly indicate that the diet should be modified by way of concentrating it.

In constructing what we term, for convenience, concentrated diets, we aim at two things.

(1) To give the necessary nutritive value in an appreciably smaller bulk than that of our ordinary diets.

(2) To give the diet generally in a more easily taken form, for which purpose the amount of solid food is diminished.

Method of concentration.—The first thing to do is to diminish, or even to eliminate, the amount of food-stuffs which have little or no nutritive value, for instance, soups, potatoes, green vegetables, also the amounts of those food-stuffs which are somewhat bulky, for instance, porridge, pulses, bread and suet puddings. The nutritive value of the food-stuffs thus eliminated must be replaced by the inclusion of other food-stuffs which give the same nutritive value in a smaller bulk. To keep up the protein intake to the requisite standard, the milk should be "fortified," i.e. its nutritive value should be increased by the addition to it of a soluble casein preparation such as casumen, plasmon and similar food-stuffs. This is easily done. It is also a very good thing to fortify milk puddings and soups in the same way.

We find that as much as an ounce and a half of such a casein preparation, which represents some 32 grammes of protein, may be taken daily without giving rise to the slightest disturbance of the alimentary tract. The advantage of being able to increase the protein value of a diet by 30 grammes with so little trouble is obvious.

Milk is altered in taste by the addition to it of a casein preparation so that patients usually prefer to take this food-stuff disguised in puddings, etc. Bread and biscuits fortified in the same way are also very useful, and can be bought ready prepared, for instance, as plasmon bread and plasmon biscuits.

Another good method of keeping up the protein intake is by increasing the eggs in the diet, as egg-flip, for example, which can replace some of the plain milk. Protein also can be taken by some patients very well as raw meat given either in sandwiches or in milk.

The calorie value of the diet can be conveniently maintained at the requisite level by the use of various food-stuffs. Cream, for instance, is very useful, and 5 oz. of cream can be readily given partly in the milk and partly with the puddings. Benger's food and similar starchy food preparations are also very useful.

Dislike of sugar.—A practical point to bear in mind is that patients with anorexia are mostly intolerant of sweet foods, and it is a good practice to reduce the amount of sugar contained in their food-stuffs by one-half. More or less unsweetened puddings will be well taken by febrile patients much longer than sweet puddings.

Variety.—Variety is always essential when diets of considerable nutritive value have to be taken for a very long period. Plenty of variety is especially important in the dietetic treatment of patients with fever. Free use should be made of all the ordinary roast joints and meats, of poultry, game, etc., varied by made up dishes such as mince, hashes, stews, etc.; sweetbreads and sausages also make a change. Puddings may be readily varied, so long as their ingredients are of a high nutritive value, such as egg, milk, cereals, bread, flour, etc. Blancmanges, cream, gelatine, junket, custards, etc., are very useful puddings with which to vary the diet.

It is perhaps not out of place for us to say that the controlling of fever by the use of sponging or various antipyretic drugs, is often a very great aid in the dieting of patients with febrile anorexia. The reduction of temperature by some such methods in the course of the hour before meal, often sufficiently improves the condition of the patient, if only temporarily, to allow of his taking his food with much less difficulty. The prescription, also, of an ordinary bitter tonic half an hour before meals is often of considerable service in all types of anorexia.

The following two dietaries which are examples of the concentrated diets we are in the habit of prescribing will be found very useful.

The first, which is our ordinary standard diet fortified and somewhat concentrated, is suitable for patients with a moderate degree of anorexia. The second is a more or less fluid diet and is suitable for patients with continuous high fever.

These two diets are illustrative and show the principles upon which concentrated diets should be constructed; to be thoroughly satisfactory they should be constantly varied, as patients with anorexia very soon tire of any food if continuously given in the same form.

ANOREXIA DIET 1.

	Men.	Women.
Breakfast—		
Milk	1 pt.	1 pt.
Tea or coffee (chiefly for flavouring milk)	Small quantity	Small quantity
Bacon, etc.	1½ oz.	1½ oz.
Egg		
Bread or toast	2 oz.	1½ oz.
Butter	½ oz.	½ oz.
11 a.m.—		
Milk and casein	½ pt.	½ pt.
Lunch—		
Milk	½ pt.	½ pt.
Fish or entrée	2 oz.	2 oz.
Meat, fowl or game	2 oz.	2 oz.
Potatoes, etc.	Small amount	Small amount
Bread or toast	2 oz.	1½ oz.
Butter	½ oz.	½ oz.
Milk pudding, stewed fruit and custard, junkets, creams, etc. (perhaps containing casein)	Ordinary helping	Ordinary helping
4 p.m.—		
Tea, bread and butter, etc.	Small quantity if desired	Small quantity if desired
Dinner—		
Milk	½ pt.	½ pt.
Fish	2 oz.	2 oz.
Entrée, fowl, game, etc.	2–3 oz.	2–3 oz.
Bread or toast	2 oz.	1½ oz.
Butter	½ oz.	½ oz.
Light pudding, jellies, fruit, custard, etc. (perhaps containing casein)	Ordinary helping	Ordinary helping
Dessert	q.s.	q.s.
Bedtime—		
Milk and egg	½ pt.	½ pt.

ANOREXIA DIET 2.

For Men or Women.

8 a.m. (on waking)	Milk, ½ pt.
9 a.m. Breakfast	Milk (with casein) made into tea or coffee, ½ pt. Boiled bread and milk, ½ pt. 1 egg poached or scrambled on small piece of buttered toast.
11 a.m.	Benger's food with casein, ½ pt.

1 p.m.	Milk, ½ pt.
	Toast (or rusks) and butter, ½ oz.
	Pounded chicken, etc. / Steamed fish or raw meat sandwiches } 2 or 3 oz.
	Thin custard, ½ pt.
4 p.m.	Tea made with milk, ½ pt.
6 p.m.	Milk, ½ pt.
	Fish or pounded chicken, etc., 2 or 3 oz.
	Toast (or rusks) and butter, ½ oz.
	Junket, light pudding, etc., 5 oz.
9 p.m.	Benger's food with casein, ½ pt.
During night	Milk and egg (with or without alcohol), ½ pt.

1½ oz. of casein should be worked into the diet daily and 5 oz. of cream added to the day's supply of milk. The nutritive value of this dietary is P. 175, F. 160, C.H. 200, Cals. 3,025.

If the anorexia is very persistent and severe it is often advisable to give the diet more often and in smaller amounts ; sometimes, also, especially in the case of those who are very acutely ill, it is good practice to give some of the food during the night. The following is an example of a fluid diet given in small amounts fairly frequently. This diet which we have found in practice to be readily taken by patients who are very ill has a high nutritive value, viz., protein, 160 ; fat, 165 ; carbo-hydrate, 213 ; and calories, 3,063.

FLUID DIET.

8 a.m.	Milk, ½ pt.
9 a.m.	Milk with casein (coffee for flavour), ½ pt.
	Bread and milk, ½ pt.
11 a.m.	Benger with casein, ½ pt.
1 p.m.	Milk with casein. Bovril, ½ pt.
	or
	Raw meat, milk.
	or
	Raw meat sandwiches, 2 oz.
3 p.m.	Egg and milk or thin custard, ½ pt.
5 p.m.	Milk tea, ½ pt.
7 p.m.	Leube Rosenthal meat solution, ¼ tin.
	or
	Raw meat, milk, ½ pt.
	or
	Milk bovril, ½ pt.
	or
	Milk and arrowroot pancreatized, ½ pt.
10 p.m.	Benger with casein, ½ pt.
4 a.m.	Milk and egg (with or without alcohol), ½ pt.

THE DIETETIC TREATMENT IN TUBERCULOSIS OF VARIOUS ORGANS

Laryngeal tuberculosis with dysphagia.—The general principles which we have laid down for the dieting of tuberculosis generally apply to tuberculosis of the larynx. In disease of this organ, which is nearly always co-existent with tuberculosis of the lung, there is the same necessity for maintaining a high level of nutrition. The treatment of patients with laryngeal tuberculosis who have no difficulty in swallowing requires no special notice, but the existence of dysphagia calls for very special treatment. In many cases the dysphagia is of quite slight degree and far from being severe enough to prevent the patient taking an ordinary diet. In general terms it may be said that when a patient can take an ordinary diet without appreciable inconvenience, he should be advised to do so, as the taking of a generous diet is thus rendered much easier and will often bring about rapid improvement in the laryngeal condition with loss of the pain on swallowing. In the case of such patients, however, it is a good plan to inquire whether there is any particular food-stuff which causes pain and if there is to omit the same from the diet. When the dysphagia is severe enough to prevent the patient taking an adequate diet in an ordinary form semi-solids or fluid diets must be relied upon until such time as improvement in the general condition and the condition of the larynx makes it possible to return again to ordinary diet.

When semi-solids and fluid diets are prescribed considerable care must be exercised in the arrangement of the meals to ensure a sufficient amount of nutriment being taken. As a matter of experience, we have found that semi-solid diets are often taken more readily than fluid diets, the latter having more tendency to "go down the wrong way." This tendency can, however, be considerably lessened by the patient taking a fluid diet in the Norris-Wolfenden position. Another advantage of the semi-solid diet is that a high nutritive value can be given in this form in a good deal smaller bulk than in a fluid diet. The bulkiness of a fluid diet is very apt to give rise to dyspepsia.

Constant slight variations should be made in the diet whether fluids or semi-fluids are used, as patients soon tire of either of them. In practice, it is usually best to compromise between a semi-solid and a fluid diet or to alternate them. In no form of tubercular disease is there the same necessity for the constant close attention to dietetic detail as exists in these cases of laryngeal tuberculosis, and the secret of success in treating such cases lies in making a close study of every individual case, carefully seeing what solid foods, if any, can be taken, building up the necessary diet round these food-stuffs, allowing the patient at the same time to indicate his own preferences and then varying the diet judiciously day by day. All food-stuffs should be given cold and very often if the fluids are iced they are taken more easily. Anything of an irritating nature, such as pepper and similar condiments, should be omitted.

When the pain in swallowing is very severe it may be necessary to give food in small amounts every four, or three, or even two hours during the day. At all costs the taking of an adequate diet must be secured. There are several measures at our command which are often of the greatest assistance to these patients. The insufflation of the larynx with orthoform or anasthesin between meals will often allay pain sufficiently to allow of food being taken much more readily. The application, also, of cold to the larynx—preferably by the use of a Leiter's laryngeal coil is often of distinct service in this respect. Again, taking the food when in the Norris-Wolfenden position, i.e. when lying on the side, the food, if liquid, being taken through a tube from a vessel placed slightly below the level of the mouth, or in the Wolfenden position, viz., the patient lying on his chest with the head somewhat dependent and taking the food in the same way, may help considerably.

In the construction of diets for patients with dysphagia many of the concentrated foods which we have described in the article on the treatment of anorexia, etc., will be found very useful. Full use should be made of all the various foods from time to time, so as to get plenty of variety. The following examples of diets which we have used with satisfactory results may perhaps be of value as showing how they should be constructed.

FLUID DIET SUITABLE FOR PATIENTS WITH DYSPHAGIA.

8 a.m.	Thin Benger's food, 1 pt.
10 a.m.	Egg, 1 ; milk, 5 oz.
11 a.m.	Milk and sanatogen, or soluble casein preparation, 1 pt.
1 p.m.	Milk cocoa, 1 pt.
3 p.m.	Junket, 1 pt.
5 p.m.	Thin Benger's food, 1 pt.
7 p.m.	Milk bovril, 1 pt.
9 p.m.	Egg, 1 ; milk, 5 oz.
10 p.m.	Thin Benger's food, 1 pt.
During night	Milk and sanatogen, etc., 1 pt.

Total—Benger's food, 3 pts.
Milk and sanatogen, etc., 2 pts.
Milk in other forms, 3½ pts.
Eggs, 2.

Approximate nutritive value : Protein, 180 ; Fat, 210 ; Carbo-hydrate, 280 ; Calorie value, 3,940.

Dysphagia patients constantly fail to take the prescribed diet well at some time every day. As the nutritive value of the above diet is very considerable a certain amount of latitude may be allowed in this respect, and at the same time the patient should be encouraged to persevere with the full diet.

The fluid diet mentioned in discussing the treatment of anorexia, etc., is also frequently suitable.

SEMI-SOLID DIET SUITABLE FOR PATIENTS WITH DYSPHAGIA.

7 a.m.	Egg and milk, 1 pt.
9 a.m.	Arrowroot or cornflour milk, or typhoid bread and milk, 1 pt.
11 a.m.	Gelatin blancmange or cream (flavoured).
1 p.m.	Steamed fillets of fish, or 4 eggs scrambled with 1 oz. butter.
3 p.m.	Junket and cream, 1 pt.
5 p.m.	Milk and raw meat juice, 1 pt.
7 p.m.	Velvet soup, 1 pt.
During night	Benger's food or milk, cocoa etc., 1 pt.

Approximate nutritive value : Protein, 164 ; Fat, 210 ; Carbo-hydrate, 220 ; Cals., 3,013.

Hæmoptysis.—It is very difficult to dissociate the dietetic treatment of hæmoptysis from the general treatment of this complication. The dietetic treatment of hæmoptysis varies very considerably with the cause and severity of the bleeding and the condition of the patient.

It must be remembered that hæmoptysis may be anything between slight discolortaion of the sputum to a loss of blood amounting to several pints. Slight discoloration of the sputum is by no means uncommon among consumptives and is probably the result of some local congestion. Such cases rapidly clear up if kept at rest for a day or two and usually require no special dietetic treatment. If, however, the discoloration continues or if the bleeding is from the commencement rather more marked it is desirable to restrict the diet somewhat particularly in the amount of fluid taken, in order to reduce blood pressure to some extent. This is easily accomplished by cutting off all tea, coffee, etc., reducing the amount of milk taken to 1 pint a day, and for a day or two reducing the amount of solid food taken to a slight extent.

In the case of severe hæmoptysis, due probably to the erosion of a blood vessel or the rupture of a pulmonary aneurism, the indication is to reduce blood pressure as quickly as possible and to maintain it at a low level for some days after all bleeding has ceased. For this purpose the diet should be small in bulk and should contain but very little fluid. For the first 24 hours after a severe hæmorrhage little or no food should be given, milk in small amount, 1 or 2 teaspoonfuls at a time, being allowed to allay thirst more than for any other purpose. Milk should be iced and the mouth should be washed out at intervals with iced water, or small lumps of ice may be given to suck. Such patients suffer a great deal from thirst, especially if they are treated by free purgation with salts; ice relieves the thirst better than anything else, but care must be taken that the patient does not swallow a considerable quantity of fluid in this way.

During the next few days the diet should be small in amount, unstimulating, and should not contain an excessive amount of fluid; 1½ pints of milk, and 3 or 4 oz. of toast and butter, and an egg or shredded meat sandwiches will be ample and should be taken cold and in small quantities at a time.

The diet should be increased on the third or fourth day after the attack and the original diet may in most cases be resumed in ten days' time. The following diet which was taken by a patient with hæmoptysis on the fourth day after the attack is a good example of the kind of diet we prescribe.

8 a.m.	One egg beaten up with milk, 1 oz. Toast, 1 oz., buttered.
10 a.m.	Raw meat sandwich, bread, 1 oz.; meat, 1 oz.; butter.
12 noon	Custard pudding, 3 oz.
2 p.m.	Benger's food, 3 oz.
4 p.m.	Pounded chicken or fish, 3 oz. Bread or potatoes, 1 oz.
6 p.m.	Milk and casumen, 2 oz. Toast, 1 oz., buttered.
8 p.m.	Poached egg on toast.
10 p.m.	Junket, custard, 3 oz.
2 a.m.	Benger's food, 3 oz.
4 a.m.	Milk and casumen, 4 oz.

Such a dietary is easily taken, has a very fair nutritive value, and is small in bulk. If the patient's condition is satisfactory it is advisable to continue the use of a diet of this kind, but gradually increasing the amount and the intervals for giving food, until the sputum is clear, at which date an ordinary diet can usually be safely resumed. Throughout the week or ten days following the hæmoptysis, and prior to the clearing up of the sputum, a careful watch should be kept upon the blood pressure, which can be controlled to a very considerable extent by careful dieting and the exhibition of saline purgatives. With a satisfactory low blood pressure the diet can often be gradually approximated to the normal diet before the sputum has completely cleared. Where there is much exhaustion or high fever a few days after the hæmoptysis, it is wiser to increase the diet more rapidly, controlling the blood pressure as much as possible in other ways. In patients who have a succession of hæmorrhages, the dietetic indications are very similar, viz., the strength of the patient must be maintained at all costs, but at the same time the pulse rate and the blood pressure should be controlled as far as possible. It is impossible to lay down more precise instructions in the dietetic treatment for such cases.

Tuberculosis of the intestines.—The special indications in the treatment of this condition are:

1. To prevent irritation of the diseased area.
2. To prevent excessive peristalsis.

To fulfil these conditions the diet must be composed of food-stuffs which are fairly completely absorbed and leave only a small amount of unirritating residue; the total bulk of food taken must be small and the diet fairly dry.

The following food-stuffs are of service in this condition :

Raw meat either in milk or better still in sandwiches; raw meat is very readily absorbed and leaves little residue.

Underdone meat is suitable for the same reasons. Well done meat should be avoided as irritating fragments are apt to be left undigested.

Leube-Rosenthal meat solution is a very useful food-stuff in these cases; half a tin may be given daily in addition to other meat.

Milk.—Milk should not be given in excessive amount as the hard curd which is frequently formed unless the milk has been specially prepared is apt to irritate. It is better to give a considerable proportion in the form of Benger's food which, when prepared, is partially digested and incapable of producing a hard curd; or the milk may be pancreatized.

Eggs are most useful and should be used freely.

Cheese is a suitable food-stuff if carefully dissolved and the free acid neutralized by the aid of bicarbonate of soda; the solution can then be used in the preparation of various savoury dishes.

Butter and cream should be given freely in place of much of the carbo-hydrate of the ordinary diet.

Bread is best taken toasted and plain biscuits may be given with advantage.

Most *puddings*, particularly the custards, blancmanges, creams and some milk puddings will be found satisfactory.

The following food-stuffs should be avoided :

Porridge, soups, potatoes, green vegetables and fruit (except in very small amounts), tea and coffee (except for flavouring). Casein preparations tend to set up diarrhœa and should be used very carefully.

Finally, food should be given in small quantity at fairly short intervals in the majority of cases.

The following dietary may be found useful and serves to illustrate the main points.

8 a.m.	Two eggs scrambled.
	Steamed fillet of fish, 2 oz.
	Toast, 2 oz.
	Butter, ½ oz.
	Milk coffee, ½ pt.
11 a.m.	Leube-Rosenthal meat solution.
1 p.m.	Underdone meat (minced), 3 oz., or raw meat sandwiches.
	Toast and biscuit, 2 oz., butter, ½ oz.
	Blancmange, milk pudding, etc., 5 oz., with cream, 2½ oz.
	Tumbler of milk.
4 p.m.	Milk tea, ½ pt. (or Benger's food).
	Toast, 2 oz.
	Butter, ½ oz., egg.
7.30 p.m.	Steamed fish, 2 oz.
	Underdone meat, 3 oz.
	Toast, 2 oz.
	Butter, ½ oz.
	Sweet pudding, 5 oz., with cream, 2½ oz., or cheese custard.
10 p.m.	Benger's food, ½ pt., or Leube-Rosenthal meat solution.

Approximate nutritive value of above dietary : Protein, 163 ; Fat, 165 ; Carbo-hydrate, 220 ; Calories, 3,100.

SUPERVISION OF PATIENTS' DIETS

It is a very important matter, in the treatment of tuberculosis, to make sure that the diet prescribed for any patient is taken properly. When insisting that a patient should eat the whole amount of food ordered for him, it is absolutely essential that the diet be most carefully constructed. Undoubtedly diets are often prescribed which are obviously too large, on the principle that the patient will certainly leave some of the food. This is a very unsatisfactory method of trying to make sure that a patient takes an adequate diet ; at the best, it is quite haphazard, and, indeed, often fails in its object. It is clearly far more satisfactory to work out very carefully the necessary diet ; the physician can then with confidence urge upon the patient the necessity for taking it all. As a matter of fact, the necessary diet is by no means a big one, and can be readily taken by the ordinary patient, whereas the sight of a very large diet disheartens him. In sanatorium practice, it is best to practise those people who serve the prescribed meals in determining the weights of various food-stuffs. If the meals are weighed regularly for a little time, the eye gets very well trained to various weights, and diets of definite nutritive values can thus be readily given as prescribed. In private practice, we advise patients to buy a light pair of French scales and, at first, to weigh out the various food-stuffs, as prescribed, very carefully. After a little practice, patients become sufficiently experienced to guess the amounts with quite sufficient accuracy to ensure the taking of the prescribed amounts. If patients are in the habit of leaving a material amount of their meals, what is left should also be weighed and recorded by some responsible person. The mere fact that such a record is kept, is often a very wholesome stimulus to the patient.

DIRECTIONS FOR THE PREPARATION OF CERTAIN FOODS USEFUL IN THE TREATMENT OF ANOREXIA, HIGH FEVER, DYSPHAGIA, ETC.

Milk Bovril.

Milk may be completely disguised by making "Invalid Bovril," or other meat extract preparation, as directed upon the bottles, but using boiling milk instead of water.

Milk Tea.

Place several teaspoonfuls of tea in a hot jug and pour upon them three or four tablespoonfuls of boiling water; stand three minutes and add a pint of boiling milk; stand another minute and then strain off the leaves and serve.

Milk fortified with sugar of milk is too sweet for the liking of most tuberculous patients, but the carbo-hydrates may be increased considerably by fortifying with starch.

Milk fortified with Starch.

Ingredients: Milk, 1 pint, cornflour, arrowroot or farina, 2 oz., Benger's liquor pancreaticus, 1 teaspoonful.

Mix the cornflour into a thin paste with a little milk, boil the rest of the milk and pour it upon the mixed cornflour, stirring continually until the whole mass thickens. Now add the liquor pancreaticus, stirring continually until the preparation is as thin as ordinary milk, which should occur in 1 or 2 minutes. The preparation is immediately boiled to prevent further change occurring. Essence of lemon, etc., tea, coffee, bovril, etc., may be used for flavouring.

Milk fortified with Casumen or other Soluble Casein.

Ingredients : Milk, 1 pint, 3 tablespoonfuls (⅓ oz.) moderately heaped of casumen.

Mix the casumen with the milk by dredging the powder into the milk while stirring and bring to boiling point, stirring vigorously all the time to prevent "burning."

It is possible to get double this amount of casumen into solution but this process requires more care.

This fortified milk may be used for the preparation of the cornflour above mentioned or the milk may be flavoured with tea, coffee, cocoa, bovril, Benger's food, etc., or may be taken as it is.

Milk fortified with Casein.

The most palatable result is obtained by adding dilute HCl to 1 pint of separated milk in sufficient amount to precipitate the casein; then strain through muslin and wash well to free the precipitate from lactose and acid. Dissolve in the required amount of new milk (1½ or 2 pints) with the aid of a small quantity of soda bicarbonate and warmth.

Meat Juice with Milk.

Ingredients : ¾ lb. rump steak or fillet of beef free from fat, 1 pint of milk, bovril or Brand's essence to flavour.

Pass the steak through a fine mincing machine or scrape very finely, this gives 7 oz. of meat pulp. Mix thoroughly with the milk and pass through a fine strainer or muslin, not a hair sieve. This should yield about a pint of fluid of the consistency of cream. Half a teaspoonful of bovril or some Brand's essence may be used for flavouring. Care should be taken to squeeze as much meat pulp as possible through the strainer. The preparation may be warmed by standing in a vessel of hot water, but excessive heating causes coagulation.

Meat Solution.

Leube-Rosenthal meat solution, to be obtained of Messrs. Poths and Co., of 4, Berry Court, St. Mary Axe, E.C., at 20*s*. per doz. ½ lb. tins.

Two or three teaspoonfuls should be stirred with a very little hot water in a wineglass and the glass filled with Burgundy or port according to medical direction. The preparation may be served at any desired temperature. Half a tin of this solution may be taken daily.

Raw Meat Sandwiches.

Scrape finely a sufficient amount of fillet of beef, pound it in a mortar, adding pepper, salt and any flavouring such as bovril or some sauce. Cut very thin bread and butter and make as thick a sandwich as possible. One oz. of bread should be sufficient for 1½–2 oz. of meat and ½ oz. of butter.

Albumin Water.

Beat up the whites of two eggs without making froth, add 14 oz. of water and ½ glass of sherry. Flavour with lemon and essence of lemon. A few crystals of citric acid may be added if the patient suffers greatly from thirst. Sugar, etc., to taste. Put the fluid into a Sparklet syphon and aerate. This is useful when high fever is present.

Artificial Koumiss.

Ingredients : 3 quarts skimmed milk, 1 quart buttermilk, 6 oz. sugar. A small amount of yeast is occasionally required.

Keep at a temperature of 80° Fah. until separation commences, then bottle in Sparklet syphon.

Milk may be still further fortified with cream to the extent of 2 oz. of single cream to the pint without making the milk too rich. This is useful when vomiting is very persistent.

The following preparations are specially useful in dysphagia.

1. Custards. Heat ½ pint of milk and add 2 beaten up eggs and stir until thick. The milk used may contain milk casein at the rate of 1 tablespoonful to the pint or may have been previously flavoured with meat extract, e.g. invalid bovril, in which case a savoury custard results.

2. Cheese custard. Dissolve 2 oz. of old cheese grated in ½ pint of milk with the aid of a pinch of bicarbonate of soda and gentle heat. Make into a custard with eggs in the usual way and bake.

3. Velvet soup. Clear soup or stock (without salt) containing a tablespoonful of casumen to the pint, should have one or two beaten eggs stirred in when very hot immediately before serving.

4. Steamed fish. Place a few scraps of butter on a fillet of fish, cover with grease paper and cook between two plates for 15 to 20 minutes. Fish so treated is practically a semi-solid.

5. Scrambled eggs. Use four eggs and ½ oz. of butter for each meal.

6. Creams and blancmanges made with gelatin are much better taken by patients with dysphagia than those thickened with farinaceous materials.

7. One third of an oz. of gelatin will thicken milk sufficiently to make it possible for the patient to take it satisfactorily when plain milk can only be taken with great pain.

8. Egg and milk is sometimes more easily taken if slightly thickened with gelatin.

9. Benger's food may be made of any degree of consistency, while milk fortified with casein may be used instead of plain milk.

10. Junket is frequently well taken but should be prepared shortly before it is required.

11. Typhoid bread and milk is frequently appreciated by patients. Boil half a round of bread without crust in half a pint of milk for 10 minutes, strain through fine muslin and serve.

DIET IN GOUT, RHEUMATISM AND RHEUMATOID ARTHRITIS

CHAPTER XII

DIET IN GOUT, RHEUMATISM AND RHEUMATOID ARTHRITIS

By Arthur P. Luff, M.D., F.R.C.P.

DIET IN GOUT

General principles.—No hard-and-fast lines as to dietary can be laid down in the treatment of gout. Each individual must be carefully considered as regards his habit of body, his capacity for the digestion of different articles of food, the amount of exercise he is able to take, and the nature of his work. Derangements of the gastro-intestinal tract constitute a most important factor in the development of acute, chronic and irregular gout; in all forms of gout, whether regular or irregular, there is one invariable symptom, viz., digestive disturbance. It is, therefore, of the utmost importance to secure and maintain a healthy condition of the gastro-intestinal mucous membrane, and a normal daily evacuation, in order to guard against auto-intoxication, which is undoubtedly an early factor in the development of the gouty condition. The individual who is subject to gouty attacks can certainly diminish the number and severity of the attacks, and in many cases can prevent their recurrence, by careful attention to diet, to the quality and the quantity of fluid taken, to exercise, and to a sufficient daily action of the bowels.

Gouty people may for the purposes of the consideration of diet be roughly grouped into three classes :—

(1) Those who suffer from more or less frequent attacks of acute gout; (2) those who have never suffered from an acute attack, but who are constantly subject to some chronic form of regular or irregular gout, especially after slight indiscretion in diet; and (3) those who are only affected with gouty symptoms (generally of the irregular kind) when they eat or drink certain

articles, and who therefore in order to avoid these gouty symptoms have to be specially watchful over their diet. As Mouillot has observed, it will usually be found that patients in classes 2 and 3 are the offspring of those who have suffered from acute gout.

In advising as to the diet of any particular gouty individual the personal factor is a most important one to consider, and it is wise to gain some knowledge as to the likes and dislikes of the individual with regard to food. In this connexion it is well to remember the saying of Sydenham, that "more importance is to be attached to the desires and feelings of the patient, provided they are not excessive, than to doubtful and fallacious rules of medical art."

It is well known that the excessive consumption of rich nitrogenous food, combined with excesses in wine and malt-liquors, both induces and excites gout. The comparative immunity of females and young people from gout is mainly explained by the absence of such determining causes of the gouty attack, combined, in the case of young people, with the absence of predisposing cause, and also with the fact that the secreting functions are in full activity. The subjects of gout are generally persons who live well and consume a large amount of animal food. Budd, speaking from a long and extensive professional connexion with a large rural district, states that he never knew an instance of gout occurring in an agricultural labourer.

Digestibility of food.—Gout, which is a toxæmia originating to a great extent in the alimentary tract, derives its toxic products from the improper digestion of food-stuffs. Whatever articles of food can be properly digested by the gouty, are therefore suitable articles for their dietary. The physical condition of an article of food to a very great extent determines its digestibility. By digestibility is meant not necessarily the extent to which it is absorbed into the blood, but the power of disposing of the food by the stomach, without the production of discomfort or pain. The digestibility of the various kinds of fish, and of the flesh of birds and animals, depends on the length of the muscular fibres, and on the amount of fat deposited between the fibres. The shorter the fibres, and the smaller the amount of fat deposited between them, the more digestible will the article of food be.

If an article of food tends to be swallowed in a solid lump, such for instance as new bread or new potatoes, so as to prevent the ready permeation of the substance by the digestive juices, it tends to be indigestible purely by virtue of its physical condition. If such article were first reduced to minute subdivision by thorough mastication and insalivation, its indigestibility, as far as ordinary individuals are concerned, would disappear.

It is not so much a matter of importance to know whether any particular article of food contains uric acid or its antecedents or not, as it is to know what its properties are as regards digestibility and as regards its influence on the processes which are concerned in the conversion of food-stuffs into body-stuffs. The researches of Pawlow have shown that the food value of any particular article of diet must depend to a large extent upon the amount of energy necessary for its digestion.

If gouty persons partake of meals of too complex a character, then, owing to the abnormal intestinal and hepatic metabolism of such subjects, **excessive production** and **imperfect elimination of toxic products** may result. Although both excessive production and imperfect elimination of these abnormal products of digestion go more or less together, yet it is a matter of fairly frequent observation that some gouty persons seem to be specially the victims of excessive production of toxic products, and others to be mainly affected by defective elimination.

In regulating diet it is very important to bear in mind that it is in many cases not advisable to change too suddenly the diet to which the patient is accustomed. The composition of the various digestive secretions is adapted to the food they have to digest, so that the individual who habitually eats an excess of protein in time comes to have gastric and pancreatic secretions which will digest protein well, and if the carbo-hydrates of the food have been limited he will also have a limited capacity for their digestion ; so that if a sudden change of diet is ordered, it takes a little time for the constituents of the digestive secretions to adapt themselves to the altered food, and in the meantime the patient may feel worse for the change of diet which will ultimately benefit him. The diet suitable to any patient will depend on the digestive capability of that patient, and should be regulated accordingly; it is important to remember to treat the individual as well as the disease.

Maintenance of a healthy alimentary tract.—If, as is probably the case, the toxin or toxins of gout are produced in the intestinal tract, it is obvious that the first efforts at treatment should be directed to obtaining a healthy alimentary tract, and to modifying those habits of living which have caused gastro-intestinal derangement.

Before deciding how these objects can be obtained, it is first necessary shortly to consider some points in the digestive processes which take place in the small intestine. Under normal conditions bacterial decomposition does not take place in the upper part of the small intestine, as the duodenum and upper portion of the jejunum are practically sterile. The conditions which favour increased bacterial growth in the intestine are (1) increase in the amount of protein food (the number of bacteria in the intestine varying directly with the amount of protein food), and (2) the reaction of the intestinal contents. As long as the contents are acid, bacterial growth is inhibited, but when, owing to gastric or intestinal dyspepsia, the intestinal secretion is changed, the reaction of the intestinal contents changes, and great increase in the number of intestinal bacteria takes place, while at the same time their pathogenicity is increased. Therefore, the growth of bacteria in the intestinal tract and their pathogenicity will vary directly with the amount of protein food and the amount of catarrh present.

These facts obviously have a great bearing on the treatment of gout, and explain how it is that **excess of protein food**, and **those forms of alcohol which tend to produce intestinal catarrh, have such a strong influence on the production of gout.**

As regards the amounts of protein, fat, and carbo-hydrate that the ordinary individual of average body weight needs during the twenty-four hours to satisfy the normal nutritive requirements of the body, it may be answered in a general way that he requires enough of these food-stuffs to **establish physiological and nitrogen equilibrium** sufficient to keep up that strength of body and mind that is essential to good health, to maintain the highest degree of physical and mental activity with the smallest amount of friction and the least expenditure of energy, and to preserve and heighten if possible the ordinary resistance of the body to disease germs. Chittenden's opinion is that the smallest amount of food that will accomplish these ends is the ideal diet. There must be enough to supply the true needs of the body, but any surplus over and above what is really called for may in the long run prove an undesirable addition. It is therefore necessary to have definite and concise knowledge of the amount of protein, and the total calorific value needed by the body to maintain the latter in the highest state of efficiency, before any very exact estimate of what constitutes over-nutrition or under-nutrition can be found.

It must be understood that no diet contains an adequate amount of protein food that does not keep up a condition of nitrogenous equilibrium. If the nitrogen output persistently exceeds the nitrogen intake, it is obvious that the body is feeding on its own tissue, which means that the protein of the food is insufficient in amount. On the other hand, a diet that suffices to maintain body weight, with establishment of nitrogen equilibrium should, so far as our present knowledge goes, be quite adequate to meet all the wants of the body for protein matter.

Chittenden considers that the daily consumption of protein food, far beyond the amount required to maintain health, strength, mental and physical vigour, body weight, and nitrogen equilibrium, constitutes a form of over-nutrition as serious in its menace to the health and welfare of the human race as many other evils more striking in character. He believes that there are more people suffering to-day from over-eating and over-nutrition, than from the effects of alcoholic drink. He maintains that if people, as shown by experiments, can maintain nitrogen equilibrium and body weight, gain in strength, show greater freedom from muscular fatigue, lose their rheumatic and gouty symptoms, regain a smooth and soft skin, exhibit greater freedom from colds, retain the normal hæmoglobin content of their blood, and in every recognizable way manifest a good condition of health on a low protein diet, there should be no hesitation in accepting the teaching which the scientific data point to. Chittenden's experiments show that it is quite possible to maintain body weight, and keep up nitrogen equilibrium and preserve strength, vigour, and good health on from 34 grammes to 56 grammes of protein matter per day. My own experience is that, on a diet containing this amount of protein, gouty persons maintain their nitrogen equilibrium and body weight, become free from most of their gouty symptoms, and generally enjoy a good condition of health.

Animal food.—As regards the question of meat, it must be remembered on the one hand that animal foods constitute to the majority of people the most attractive and appetizing forms of diet, and are therefore likely to be taken in excess; hence the necessity for limiting the amount to be taken. But, on the other hand, it must be borne in mind that it is most desirable to increase the combustion and the oxidative powers within the tissues. In my opinion it is absolutely erroneous to exclude from the dietary of the gouty such articles as meat, fish, and tea, because they are assumed to contain uric acid.

The so-called estimations of uric acid in those articles of diet are not, as I have elsewhere pointed out, estimations of uric acid at all. Moreover, the deduction is an erroneous one that because uric acid is a nitrogenous body, it must therefore be directly derived from nitrogenous constituents of the food, the consumption of which must consequently be avoided.

The contention that a meat diet is poisonous to the human body, on account of the uric acid that it contains, or produces, is preposterous, in view of the facts that many races have maintained robust health on such a diet, and that, for centuries, the beef-eating Englishmen have managed to spread and advance knowledge and civilization, and to acquire territory in all parts of the world. Surely, if meat is the poison which a certain class of enthusiasts and fanatics maintain it to be, we as a nation should have ceased to exist long ere this. Harry Campbell, in his interesting series of articles on "The Evolution of Man's Diet," has shown that man has evolved from the ape on a highly animalized diet, and that it was on such a diet that the intellectual faculties, and the faculty of language, which distinguish him from the beast, were developed. It is interesting to note that the recent remarkable advance of the Japanese to the position of a first-class power amongst the nations is concurrent with the adoption of a more animalized diet by them. The fact that many races in the past have been largely carnivorous as regards their diet, and that some are so even at the present time (Esquimaux, Andamanese, etc.) shows that the assumption that animal foods are necessarily poisonous to man is an entirely erroneous one. No class of food-stuff gives so great an amount of energy and produces so much heat as animal food, and no class is more easily digested by the majority of gouty people. On the other hand, the tendency with most people in this country, as I shall have occasion to remark later on, is to eat too much, and to masticate too little, and this applies not only to the consumption of meat, but of all other solid articles of diet.

On the whole, it may be stated that animal food, such as fish, chicken, game and meat, is best suited to the majority of gouty cases, whilst foods of the farinaceous class are most likely to disagree. White meats, such as chicken and fish, are more digestible than red meats. The quantity of meat, and especially of red meat, must be restricted in those cases in which the kidneys are imperfectly performing their eliminating functions, as evidenced by a pale urine, of low specific gravity, and deficient in urea and purin-bases.

Purin-free diet.—A purin-free diet is one selected from milk, cheese, butter, white bread, cereal foods, nuts, and fruit. Milk suits gouty people very well, and milk has a special effect in reducing the number of intestinal bacteria, their number being less with a milk diet than with any other.

It is true that a purin-free diet has proved of benefit in certain cases of disease, but there is every reason to believe that in such cases an equal benefit would be obtained by a mixed diet, in which the protein consumption is kept down to a minimum. So long as temperance in the ingestion of protein is observed, it matters but little from what source the protein is derived.

From Walker Hall's experiments it would appear reasonable to administer sweetbread to gouty patients, since its nuclein portion is only slightly absorbed, for thymus sweetbread contains principally adenin, which is rapidly excreted, and pancreas sweetbread contains mainly guanin, an amino-purin incapable of increasing the urinary purin output and of exerting any injurious effects upon the tissues.

Vegetable food.—A fair proportion of vegetable food should be taken with two meals each day. The choice of vegetables will depend upon the digestive capacity of the patient; but excepting the potato, as a rule those vegetables that grow above ground are preferable to root-vegetables. Whereas the mineral constituents of meat exercise a marked effect in diminishing the solubility of a gouty deposit, the mineral constituents of most vegetables exercise a marked power in increasing its solubility. The vegetables, the mineral constituents of which I find are most efficacious in this respect, are spinach, Brussels sprouts, potatoes, cabbage, and French beans. At the same time, it must be borne in mind that with certain patients some of these vegetables may tend to produce some form of dyspepsia; and I cannot too strongly urge that in the dieting of the gouty no hard-and-fast rules can be laid down, but the idiosyncrasy of each patient to various articles of diet must be made the subject of careful observation and study. Due consideration should also be given to the patient's experience of what articles of diet disagree with him.

Starchy and saccharine foods.—A diet that too largely consists of bread and starchy material leads to gravel in a number of cases. The frequency of uric acid gravel and stone among the rice-fed Hindoos is well known.

Starchy articles of food should be especially limited in amount in those gouty individuals who are subject to gastric hyperacidity (hyperchlorhydria). This condition is not due to gastric fermentation, but to an excessive secretion of hydrochloric acid by the gastric glands, and is a common cause of dyspepsia, and ultimately of gastric dilatation. It is due to an acid dyscrasia, as the result of which the secretion of gastric juice does not cease with the digestion of the protein materials of the food, but continues after they have been disposed of. The result is that a considerable portion of the starchy materials is kept back in the stomach, and this retained starch keeps up the gastric secretion, without at the same time giving it any work to do.

When intestinal fermentation and putrefaction occur, as evidenced by a sense of discomfort after a meal, I attach great importance to the reduction of the starchy articles of food, but not to the total exclusion of, what I believe to be comparatively harmless, the **potato.** It is remarkable how frequently one hears from gouty patients the emphatic statement, "I never eat potatoes." I must confess that I do not know of any good and sufficient reason for this wholesale condemnation of this common article of diet. Undoubtedly amongst those gouty patients who suffer from inability to digest starchy articles of diet—in other words, who suffer from amylaceous dyspepsia—a reduction for the time in the amount of starchy foods taken, including potatoes, is desirable; but the recognition of the existence of amylaceous dyspepsia is a fairly easy matter, and when present it can be suitably treated. Certainly those who are gouty and fat should be very sparing in the use of potatoes, as of other carbo-hydrate forms of food. I wish, however, to protest against the too general exclusion from the food of the gouty of so common and useful an article of diet as the potato. The best form in which potatoes can be taken by the gouty is the crisp form, which requires thorough mastication and insalivation. Boiled new potatoes should be absolutely interdicted to the gouty.

Equally wrong, in my opinion, is the total exclusion of **sugar** from the dietary of all gouty individuals. Undoubtedly in certain individuals sugar may do harm, as in the cases of gouty persons who are fat, or who suffer from glycosuria, or who are prone to attacks of eczema; and in such it should be cut off; but that is no reason for the exclusion of it from the dietary of all gouty patients. I know of many gouty individuals who take sugar with absolute impunity. Some gouty subjects undoubtedly digest very badly all starchy articles of diet, and in such fats may well take the place of starches. Fat bacon, properly cooked, is generally well digested by gouty individuals.

Subjects who are both gouty and fat should avoid sugar, but undoubtedly sugar may be taken with advantage by those who are gouty and thin, and such subjects may also take in moderation marmalade and wholesome jams. **Bread** may advantageously be given as crisp toast, or in the form of rusks, or in the "Zwieback" or twice-baked form, as in these conditions it requires thorough mastication and insalivation.

In those cases in which it is desirable to reduce the carbo-hydrate intake such restriction may be achieved :—(1) By cutting off sugar, and all articles containing any form of sugar; (2) by carefully graduating (by weight) the daily intake of starch-containing foods, so as to attain the minimum consistent with adequate nutrition in each individual case; (3) by similarly graduating the intake of fats if necessary; and (4) by throwing the onus of nutrition to a considerably greater extent than previously upon fish, lean meat, green non-starchy vegetables, and gelatinous soups.

Fruits.—Any fruit which from experience is known to agree with the individual may be taken by gouty subjects. Apples and oranges generally agree best. Uncooked fruit should never be taken at a meat meal, and is best consumed fasting fairly early in the day, as between breakfast and lunch. It should always be thoroughly masticated.

Strawberries are frequently avoided by the gouty owing to their producing in some subjects a certain amount of temporary irritation of the skin, but such irritation generally passes off in a short time. In a few subjects strawberries produce eczema or some other rash, but such cases merely represent idiosyncrasy to the special fruit, and necessarily such individuals, whether gouty or not, should not eat strawberries. I am, however, strongly of opinion that the indiscriminate banishment of strawberries from the dietary of the gouty is unnecessary. Except in those cases in which there is an idiosyncrasy to their use they constitute a good article of diet for the gouty, on account of their delicious flavour, their antiscorbutic properties, and their richness in potassium salts. It is, however, very necessary that they should be ripe and fresh. They are soon prone to decomposition, and in such a state they aid in the development of those intestinal fermentations which are so inimical to the gouty.

Beverages.—It is my custom to question closely each gouty patient that I see, not only as to the nature of the beverages taken, but also as to their amount; and my general experience is that the great majority of people suffering from gout take an insufficient quantity of water to drink. Consequently there is an insufficient flushing of the liver, kidneys, and other organs and tissues, and therefore imperfect removal of waste and toxic products. More especially does one find this insufficient consumption of fluid among female patients, in many cases due to the absurd and erroneous belief that a diminution in the amount of fluid taken tends to keep down the body weight and to prevent the occurrence of obesity. Taking from my casebooks ten consecutive cases of gout occurring in ladies whom I carefully questioned as to the amount of fluid consumed per diem, I find that amongst these ten the amount averaged only 26 fluid ounces; this included all fluid, whether taken as water, tea, coffee, soup, wine, ale, etc. The amount is obviously insufficient for the proper flushing of the system. For the treatment, as well as for the prevention, of the gouty condition the free consumption of water apart from meals is most desirable.

Only a small quantity of fluid should be taken during meals, but during the day from two to three pints of some pure water should be taken. In many cases the ordinary tap water answers perfectly well, but if it should happen to be too hard a water, or of doubtful purity, then some simple water, such as still Salutaris, Contrexéville, etc., may be taken.

"Imperial drink" constitutes an excellent febrile drink for the gouty, and in cases of chronic gout may advantageously be taken when the urine is high coloured and when it deposits amorphous urates on cooling. It is made by dissolving a teaspoonful of powdered cream of tartar (potassium bitartrate) in an imperial pint of water or barley-water, and then sweetening to taste with loaf-sugar which has been flavoured by rubbing against the rind of a fresh lemon. In place of the sugar, an ounce and a half of syrup of lemon may be added to the pint of liquid. In cases of obese individuals the drink should be sweetened with saccharin or saxin in place of the sugar. The question of alcohol is fully dealt with later on.

Simplicity of meals.—The diet of gouty patients should be simple, that is, the meals should not be made up of too many articles. Simplicity of food means facility of digestion. Moderation in both eating and drinking is perhaps one of the most essential points to insist on in the dietary of the gouty. Certainly meat, even red meat, should not be excluded from the diet. No class of food-stuff is so productive of energy as animal food; and as most cases of chronic gout are suffering from lowered vitality and want of tone, animal food, at all events in moderate quantity, is distinctly indicated. My experience supports the truth of this view, as I advise, in the great majority of cases of chronic gout, the taking of one meat-meal a day. The exclusion of any article of diet or of any class of food, without taking into account the surroundings of the case and the peculiarities of the individual, is unscientific. Those articles of diet that are known in the individual to favour intestinal fermentation and putrefaction should certainly be avoided, and, speaking generally, a sense of discomfort after a meal indicates that some article or articles of food have been taken which are not beneficial to the individual in his present condition.

If the gouty symptoms are due to over-production of toxic-material from faulty intestinal and hepatic metabolism, and if at the same time the kidneys are sound, then a diet which mainly consists of animal food is indicated, and in extreme cases of this class even the so-called "Salisbury diet" may be useful. If, on the other hand, the symptoms are due to defective elimination on account of diseased kidneys, then a diet which is more vegetarian will be best. The value of the so-called "Salisbury diet" consists in the small amount of energy necessary for the digestion of so simple a diet, and in the fact that it contains little which can set up intestinal fermentation or putrefaction. On the other hand, a strictly vegetarian diet requires more digestive energy than a purely animal one, and a much larger quantity of vegetable food must be taken to produce an equal nutritive effect.

In connexion with the question of the amount of food necessary for the maintenance of the most perfect health, it is very important to bear in mind the necessity of the adoption of the habit of thorough mastication and insalivation of food. This applies not only to the gouty, but to every one. The thorough mastication and insalivation of food has a very striking effect upon the appetite, leading to the choice of a more simple dietary and enabling it to be satisfied with a diet which is considerably less in amount than the ordinary habit of incomplete mastication demands.

If, during the treatment of gout, an attack of gouty dyspepsia should at any time intervene, then a milk diet should be employed until the dyspeptic symptoms have abated.

The "Salisbury diet."—As previously stated, as little complexity as is possible in the meals is the main desideratum in the dietary of the gouty, and in a few intractable cases of chronic gout it may even become necessary to reduce the dietary for a time to the simplest possible condition, namely, to two articles of food—lean meat and water. There are a few cases of chronic gout which undoubtedly improve, and even recover, on an exclusive diet of red meat and hot water. These are generally cases of chronic gouty arthritis which have failed to yield to the ordinary methods of treatment, and which are accompanied by dyspepsia, flatulence, acid eructations, pyrosis, and offensive stools. I have successfully treated a few such carefully-selected cases of chronic gout by the employment of this, the so-called "Salisbury" treatment. It is essential, before placing a patient on such diet, that the urine should be carefully examined, as any advanced condition of kidney disease contra-indicates the employment of such a dietary. If the evidence of kidney derangement is only slight, the adoption of the dietary is not contra-indicated; but the urine must be carefully examined every two or three days, as any considerable increase in the albuminuria would at once be an indication for the discontinuance of this special diet. Gouty patients suffering from organic heart-disease with any failure of compensation should never be placed on this dietary. The dietary consists in the patient drinking from three to five pints of hot water daily, the water being taken from one to one hour and a half before each meal, and half an hour before retiring to rest, and eating from two to four pounds of beefsteak daily. The meat should be freed from fat, gristle, and connective tissue, thoroughly minced, mixed with a little water, and then warmed through with gentle heat until it becomes brown in colour. A little salt and pepper may be added, and the meat eaten in this form or made up into cakes and cooked on the grill. Later on in the treatment, part of the steak may be taken grilled, or a grilled lean mutton chop may be substituted for one of the daily meals. The course of treatment should last for from four to twelve weeks, after which a gradual return to ordinary diet should be made.

Articles of diet to be avoided by the gouty.—Rich meat-soups : Ox-tail, turtle, mock turtle, kidney, mulligatawny, hare, giblet.

Salmon, mackerel, eels, lobster, crab, mussel, salted fish, smoked fish, preserved fish, tinned fish.

Duck, goose, pigeon, high game.

Meats cooked a second time. Hare, venison, pork, lean ham, liver, kidney, salted, corned or cured meats, pickled meats, preserved and potted meats, sausages : all articles of food pickled in vinegar ; all highly-seasoned dishes and rich sauces.

Tomatoes, beetroot, cucumber, rhubarb, mushrooms, truffles.

Rich pastry, rich sweets, new bread, cakes, nuts, dried fruits, ices, ice-cream.

Diet in acute gout.—It is preferable that no food be taken for the first twenty-four hours of an acute attack of gout, but water should be drunk freely. During the acute attack the patient should be restricted to a milk diet, which may consist of milk, bread and milk, and tea made with boiling milk instead of with water. Weak tea with cold toast thinly buttered may also be taken. The free drinking of hot or cold water, of salutaris water, or of some simple mineral water, should be encouraged. The milk diet should be continued until the acute inflammation is subsiding, which stage is indicated by the lessening of the pain, and by the pitting on pressure of the affected parts. No alcohol in any form should be given during this stage, unless there are strong reasons for its administration, such as a weak action of the heart and a feeble, irregular pulse, when a little well-matured whisky diluted with salutaris water will prove the best form of alcohol. Beef-tea and any of the meat extracts or essences should be avoided at all times by gouty patients, owing to the tendency they have to irritate the kidneys, and to the fact that they are loaded with waste nitrogenous products. With the subsidence of the acute attack the patient may return to a more liberal diet, but care should be taken to avoid anything indigestible.

Diet in chronic gout and for gouty subjects.—The following plan gives an indication of the diet to be recommended to gouty subjects :—

Morning.—Half a pint to a pint of hot water, flavoured with a slice of lemon-peel, should be slowly sipped immediately on rising.

Breakfast.—A selection may be made from the following articles of diet, according to the taste of the patient : Porridge and milk, whiting, sole or plaice, fat bacon, eggs cooked in various ways, dry toast or "Zwieback bread" thinly buttered, and tea infused for three minutes and then strained from the leaves. Fat bacon is digestible when grilled, but less so when boiled. Eggs should not be taken hard-boiled.

Lunch and Dinner.—Soups suitable for the gouty are vegetable purées, and soups made by boiling beef and mutton bones with vegetables, and subsequently removing the fat which separates on cooling. These soups should not be thickened with farinaceous substances.

The varieties of fish most suitable to the gouty are whiting, sole, turbot, plaice, smelt, flounder, grey mullet, and fresh haddock.

The birds that are admissible as articles of diet are chicken, pheasant, turkey, and game (not high).

Butcher's meat, mutton, lamb, and beef should be taken at only one meal in the day, and then in moderate quantity. Two vegetables may be taken at both lunch and dinner. Any of the ordinary vegetables may be taken, except those previously mentioned as best avoided ; but those that I consider most likely to prove beneficial to gouty subjects are spinach, Brussels sprouts, French beans, winter cabbage, Savoy cabbage, turnip tops, turnips, and celery. Potatoes may also be taken in moderate quantities. Stewed fruits, or baked apples or pears, may be taken every day at one meal.

Green vegetables as salads may be taken, provided oily dressings are avoided. A simple savoury may, if desired, be taken at the end of dinner, or a small quantity of cheese, if well masticated, and if free from the penicillium fungus or mould.

Night.—Half a pint to a pint of hot water, flavoured with a slice of lemon-peel, should be slowly sipped before retiring to bed.

With regard to persons who are disposed to gout, but are not actually suffering from it, the usual mixed diet may be taken, but they should limit the starchy articles of food, and should avoid all rich sweets, rice, tapioca, and sago. Thin and ill-nourished subjects require modifications in their diet as compared with people who are stout, while those who take plenty of exercise can take food forbidden to the indolent.

Individuals who especially benefit by a reduction of diet, both as regards quantity and quality, are those overfed people who are past middle life.

Dietetic treatment of gouty glycosuria and gouty diabetes.—Careful dietetic treatment should be resorted to, without, however, restricting the diet too much. An excessively nitrogenous diet is to be avoided as tending to accentuate the gouty condition, but no hard and fast rules as to the amount of diet can be laid down. Each case must be treated by ascertaining what amount of proteins, fats, and carbo-hydrates is best borne by the individual. Toasted bread, milk, and milk puddings made with rice, sago, and tapioca are generally permissible in this form of glycosuria. The best test of the suitability of the diet is the fact that the weight of the patient is not diminishing, while, at the same time, the excretion of sugar is becoming less. The patient should, therefore, be weighed once a week, and the whole of the urine for twenty-four hours should be collected once a week, measured, and the quantity of sugar determined in a sample of the mixed urines, so that the total output of sugar for the twenty-four hours may be known.

Alcoholic drinks.—Stated as a general principle, a person who is subject to gout is better without alcohol in any form. There are, however, some who require a little alcohol, either to aid digestion or to enable them to get through their work; and here I am entirely in accord with the advice given by Goodhart, that, if a man requires any stimulant at all, it is a matter he must decide by experiment for himself, for no medical man can tell him. If alcohol is necessary or desirable, the form in which it is to be taken is frequently a matter which the patient can decide better than the medical man; but I would insist upon the importance of definitely limiting the amount to be taken, and of restricting its consumption absolutely to meals. Some patients find that a little whisky or brandy suits them best; others find a light still Moselle preferable; a few, but in my opinion only a very limited number, find a light claret agrees best with them. Champagne is a wine which is seldom suited to the gouty, especially if taken daily. In elderly people, or in the feeble, a moderate amount of pure whisky undoubtedly does good; but the indiscriminate ordering of whisky to gouty subjects is, I am sure, wrong.

It is well known that certain alcoholic drinks injuriously affect the gouty process, whilst others exert a less injurious influence. Alcoholic drinks which have been obtained by fermentation, but which have not been submitted to distillation, such as wines and beers, appear to exercise a more harmful influence than if the same amount of alcohol be consumed in the form of one of the distilled spirits, such as whisky, brandy, etc. Sir Alfred Garrod considers that the reason for the prevalence of gout in the south of England and its rarity in Scotland is chiefly to be found in the difference between the beverages drunk in the two countries.

Acidity of wines and beers.—Distilled spirits contain little or no acid, whilst wines and beers are distinctly acid; and to the acids contained in these drinks many physicians have attributed, and still do attribute, their gout-producing properties. The acids present are tartaric, succinic, malic, acetic, formic, propionic, butyric and œnanthic. The acidity of wines is mainly due to tartaric, malic, and succinic acids. The amount of free acid in sound wine, reckoned as tartaric acid, varies between 0·3 and 0·7 per cent. I found the acidity of some 1847 port, reckoned as tartaric acid, to be 0·6 per cent. Cider owes its acidity mainly to malic acid. Its total acidity is usually 0·1 per cent. If we arrange the various wines in (*a*) their order of acidity and (*b*) the order of their gout-inducing power, we find that the most acid wines are not those which most predispose to gout. The arrangement of wines and beers in the order of acidity, beginning with the most acid, is that given by Bence Jones, while the arrangement in order of their gout-inducing power is that given by Sir Alfred Garrod.

Hock, Moselle and the weaker kinds of ales have comparatively little gout-inducing power.

The acidity of alcoholic liquors cannot have much influence in determining an attack of gout, as port, sherry and malt liquors, which are the most powerful predisposing agents, are amongst the least acid, whilst the more acid wines are comparatively harmless in this respect; moreover, it must be remembered that the organic acids and their salts contained in wines are converted in the body into alkaline compounds, and are excreted in the urine as such.

WINES AND BEERS ARRANGED IN ORDER OF ACIDITY AND GOUT-INDUCING POWER.

(a) Acidity (beginning with the most acid).	(b) Gout-inducing power (beginning with the most powerful).
Moselle.	Port.
Rhine wines.	Sherry.
Burgundy.	Other stronger wines.
Madeira.	Champagne.
Claret.	Stout and porter.
Champagne.	Strong ales.
Port.	Claret.
Sherry.	Hock.
Malt liquors.	Moselle.
	Weaker kinds of ales.

Gout-inducing properties of alcoholic drinks.—The question is—To what constituent or constituents of wines and beers are their gout-inducing properties due? They are not due to the alcohol alone, for in countries such as Scotland, Norway, Sweden, and Poland, where distilled spirits are, or were, freely consumed, gout is almost unknown. Moreover, several experiments that I have made indicate that alcohol, in such quantities as are ever likely to be present in the blood, has no effect either upon the conversion of sodium quadriurate into biurate or on the solubility of the latter. The gout-inducing properties are most probably not due to the acids of the wines and beers, for the reasons which have already been given. It is also very doubtful whether the sugar present in wines is *per se* harmful; but as a rule the sweet wines are fortified wines, while the natural wines are generally dry. It is very probable that the sweet fortified wines are prone to produce fermentative and catarrhal changes in the gastro-intestinal tract, and are on that account harmful to the gouty.

The gout-inducing properties are certainly not directly due to the œnanthic ether and other ethereal salts of wines exerting any effect either on the rate of decomposition of the sodium quadriurate or on the solubility of the biurate. To demonstrate these points, I have extracted from old port wines the ethereal salts to which the bouquet of the wines is due, and have experimented with these ethereal compounds on the quadriurates and biurates. Using quantities far in excess of those likely to be present in the blood after the moderate, or even immoderate, consumption of such wine, I find that none of these volatile constituents exercise the slightest effect either in hastening the decomposition of the sodium quadriurate or in diminishing the solubility or hastening the precipitation of sodium biurate. As to the *modus operandi* of certain wines, such as port, etc., in hastening an attack of gout, I incline to the opinion that the influence of wines on the development of gout is in great part due to the effect they exercise in producing fermentative and catarrhal changes in the gastro-intestinal tract, and in also injuriously affecting hepatic metabolism. At the same time, it must be remembered that those accustomed to drink wine are also able to indulge in other luxuries of the table which greatly favour the development of gout.

As Woods Hutchinson has pointed out, the experiments of Boix appear to have shown that, in the case of alcohol, it is not the direct toxic effect of the drug, so much as the catarrhal and other irritative changes set up by it in the intestines which produce the poisonous products that are carried to the liver and cause irritation and degeneration of that organ. In other words, unless alcohol is taken in sufficient amounts to disturb gastric and intestinal digestion, it will not produce the hob-nail liver.

It must also be borne in mind that the rapidly fermentable fruit and malt sugars, the esters, and the higher alcohols, which are present in wines and beers, are more closely concerned with fermentative changes in the stomach and intestines than is the alcohol itself.

Port is a wine which is especially unsuited to the majority of gouty subjects. The gout-inducing properties of the wine are, I believe, mainly dependent upon the ethereal compounds which give the aroma or bouquet to the wine, although these bodies do not act directly on either the quadriurate or biurate of sodium. If this view is correct it would explain the well-known fact that old and matured ports are much more provocative of gout than comparatively new ports taken direct from the wood. The development of the ethereal compounds in the wine extends over many years, and especially progresses after the wine is laid by in bottles. In a few cases of asthenic gout, especially in old people, a moderate amount of comparatively new port taken direct from the wood undoubtedly does good.

In my opinion the wines which are least injurious as a rule to gouty subjects to whom it is found necessary to order a small amount of wine are the light still white wines, such as Moselle, certain French wines, certain Austrian wines, hock, and a few of the lighter Australian and Californian wines. These last, owing to their greater alcoholic strength should be taken diluted with water or some mineral water.

Gouty subjects suffering from glycosuria or diabetes should entirely abstain from alcoholic drinks, unless marked debility and loss of appetite necessitates the restricted administration of them. Gouty persons subject to attacks of eczema are also much better without alcohol in any form, and certainly entire abstention from alcohol is most desirable during the treatment and persistence of the eczema. It is best that any form of alcohol should be abstained from, but the prohibition applies more especially, in my experience, to the red wines. I have met with several cases occurring among gouty individuals past the middle age of life in whom two or three glasses of claret or Burgundy will in the course of a few hours cause the development of an eczema.

"Rough" cider, that is the completely fermented apple-juice, taken in moderation, agrees well with most gouty subjects. It contains but a small percentage of alcohol, is free from sugar, and its acidity is chiefly due to malic acid, which passes into the circulation in the form of alkaline malates, which in their turn are converted in the kidneys into alkaline carbonates and excreted as such, thereby increasing the elimination of urates. The bottled or "champagne" cider, which is imperfectly fermented, should never be used by gouty individuals, owing to its undoubted liability to set up gastro-intestinal fermentations. Dry or "rough" cider mixed with an equal quantity of an aerated water is an excellent beverage for the gouty. Dry perry is also a suitable drink for the subjects of gout.

Water and mineral waters.—The free employment of water in the treatment of gout dates from ancient times. At the Temples of Asklepios at Epidaurus and Athens, water was used extensively both internally and externally, and active gymnastic exercise, riding, friction of the skin, massage, and counter-irritation were prescribed.

Spa treatment is a complex treatment made up of several factors, and on the correct apportionment of these different factors depends much of the successful issue of the treatment. These several factors are: (1) Hydrotherapy, which includes the taking of, and the bathing in, the water; (2) diet; (3) exercise; and (4) accessory forms of treatment, such as electric light baths, electrical treatment, massage, etc. With regard to the drinking of a water at a spa there is a tendency with some medical men to consider that the efficacy of a natural mineral water is due solely to its watery constituent—in other words, that its one therapeutic use is that of a flushing agent. Even so astute a physician as the late Sir William Roberts appears to have held this view. In his Croonian lectures, referring to the employment of the waters of certain spas in the treatment of gout, he said:—"Now there can be no reasonable doubt that the efficacy of these springs has nothing to do with their scanty mineral ingredients but depends on their watery constituent . . . . Their action would be to temporarily dilute the blood and lower its percentage of urates and sodium salts. This effect would tend to retard or prevent uratic precipitation, and thus give the defective kidneys additional time to overtake their arrears in the task of eliminating uric acid."

Ionic theory and radio-activity.—If the efficacy of a natural mineral water depended solely on its watery constituent I do not for one moment think that the resort of sufferers to the various natural springs would have successfully stood the test of centuries, as it undoubtedly has. The fact is that in judging of the effect of natural mineral waters we have been too much under the domination of analytical chemistry, and that our deductions from these results have been consequently biased and cramped. The more I consider the therapeutic effects of the natural mineral waters the more convinced I am that chemical analysis, although it can inform us what are the mineral constituents of the natural waters, is yet unable to determine exactly the state of the salts dissolved in them. The "ionic or electrical dissociation theory" and the existence of the mineral constituents of natural waters as "ions" are leading our thoughts to a new and, I believe, correct appreciation of the therapeutic values of these waters.

An element or a group of elements divorced from the rest of the original molecule is an "ion." According to the ionic theory metallic salts in very dilute solutions are completely split up into their "ions" so that all the properties of these solutions must be the sum of the properties of the separate "ions." In concentrated solutions much of the salt remains in the undissociated state and only a small proportion in the form of dissociated "ions," whereas in most of the natural mineral waters, which are weak solutions of salts, the mineral constituents are mainly, if not entirely in many waters, in the form of "ions," and in this form the therapeutic effects and potency may be quite different from those of the undissociated salts. Ionic dissociation does not, therefore, alter the percentage composition of a salt, but may very materially alter its therapeutic properties, so that in all probability the "ions" rather than the salts are responsible in great part for the effects of mineral waters.

In intimate relation with this aspect of the matter is the question of radio-activity in hydrotherapy. Our conception of the atom as an indivisible and finite body is disappearing, and, in view of the recent discoveries that have been made in connexion with radio-activity, the atom must be conceived as consisting of an aggregate of corpuscles, and each atom has associated with it a definite charge of electricity, such an electrically charged atom being an "ion." The smallest unit of electric charge is known as an "electron" and the atom is charged with a number of these electrons, which are in a state of vigorous motion among themselves within the atom. Radio-activity consists in the flinging away with great violence of actual atoms. The substance left is also radio-active, and ultimately one of the residues seems to discharge electrons instead of atoms of matter, thus effecting a transmutation of matter.

Now, most, if not all, of the natural mineral waters which have been examined have been found to be distinctly radio-active, and the lower the mineralization of the water, the more intense is its radio-activity. In this, I think, lies the explanation of the fact that an artificially prepared mineral water, although it may be made identical in chemical composition with the natural one, does not possess the same therapeutic effects as the natural water, since it is lacking, at all events to any extent, in the property of radio-activity. A natural water at the moment of its discharge from the earth is radio-active, whereas an ordinary drinking water does not possess this property to any appreciable extent. Hence also the desirability of drinking the water at its source, since by the bottling and keeping of a natural water the radio-activity is to a great extent lost. When we consider the marked influence of radio-active emanations on new growths and various morbid tissues, is it too remarkable to conceive that a radio-active mineral water will exercise a potent effect on those morbid changes within the body which are connected with abnormal tissue metabolism?

Uses of mineral waters in the treatment of gout.—If gout is primarily due to the absorption of toxins from the intestinal canal dependent upon a catarrh of the intestinal mucosa, many of the natural mineral waters must be efficacious in altering the catarrhal condition and in improving the digestive processes; also the secondary effect of increasing the flow of bile and of thoroughly washing out all the tissues, so as to get rid of toxic accumulation, is important.

The value of a given mineral water in the treatment of gout depends greatly on the main object with which it is taken. For instance, it may be taken to remove gouty deposits, or to stimulate the action of a sluggish liver and to relieve portal congestion, or for the treatment of gouty dyspepsia, or to relieve the bowels in cases of torpor and gastro-intestinal catarrh, or to act on the kidneys, or to relieve gouty affections of the skin. Now it is manifest that any one mineral water is not likely to produce all these effects and it is also obviously conceivable that a mineral water which might be most useful to effect one of these purposes might prove injurious if employed to effect another. No doubt considerable error has arisen from indiscriminately sending gouty patients to a particular spa, without giving due consideration to the question as to whether the water of that spa is suitable for the treatment of the specific gouty disorder from which the patient is suffering. It is well to bear in mind that a patient should not be sent to a spa during the acute stage of gout, nor if suffering from marked organic disease of the heart or kidneys.

It is especially in cases of chronic gout, of gastro-intestinal catarrh and torpor, of gouty dyspepsia, sluggish action of the liver, gouty eczema, gouty glycosuria, and of other forms of irregular gout, that mineral waters prove so valuable, whilst the various baths, combined with massage, are so useful in producing softening and absorption of the deposits in the joints and other tissues.

The explanations given as to the *modus operandi* of a particular mineral water must sometimes be received with a certain amount of caution. For instance, the advocates of one mineral water will extol its efficacy in the treatment of gout on account of the lime salts contained in it and its freedom from sodium salts, whilst, on the other hand, the advocates of another mineral water will insist that the large quantities of sodium salts present in it and the absence of lime salts are the potent factors in its usefulness in the treatment of gout.

All gouty individuals should avoid localities in which there are hard chalky waters, or, if they have to reside in such localities, should avoid drinking the water of the district. In such cases they should drink distilled water, plain or aerated, or some of the simple natural mineral waters.

DIET IN ACUTE RHEUMATISM

The **diet during the acute stage** should consist mainly of milk, to which some common salt (about 15 grains to each half pint of milk) may be added with advantage. Vegetable soups may also be given, but meat soups, and the various meat essences and meat extracts should be avoided during the acute stage. Barley water, lemonade, infusion of tamarinds, or imperial drink should be given freely to allay the thirst. "Imperial drink" constitutes an excellent febrile drink. It is made by dissolving a teaspoonful of powdered cream of tartar (potassium bitartrate) in an imperial pint of water or barley water, and then sweetening to taste with loaf-sugar which has been flavoured by rubbing against the rind of a fresh lemon.

Another useful drink is prepared by roughly tearing a lemon to pieces, boiling it for ten minutes in a pint of water, straining through muslin, and then adding 20 grains of potassium bicarbonate, and some ice to cool.

"Tamarind tea" is another excellent febrile drink. It is prepared by stirring a heaped-up tablespoonful of tamarind pulp with a pint of hot water for a few minutes, straining through muslin, and then adding some ice to cool.

As **convalescence** is established, the patient may be put on a fuller and more liberal diet. With regard to alcohol there is no necessity to administer it in the majority of cases, but if there is severe prostration small quantities of brandy may be given. In cases complicated with severe endocarditis or pericarditis stimulants are more frequently required, and in such cases brandy may with advantage be given in the milk.

DIET IN CHRONIC RHEUMATISM (FIBROSITIS)

Under this heading are included not only the chronic joint affections, which may be left as sequelæ of acute or subacute rheumatism, and which may certainly and correctly be called true chronic rheumatism, but also that larger class of cases which are so commonly met with in practice, which are called "rheumatic," but which are not connected at all with what we know as true rheumatism. These are the cases in which the essential pathological change is an inflammatory hyperplasia of the white fibrous tissue in various parts of the body, to which the term "fibrositis" has been very aptly applied. They include the various forms of muscular rheumatism—lumbago, stiff neck, deltoid rheumatism, intercostal rheumatism, and also rheumatic neuralgia, Dupuytren's contraction, and chronic villous synovitis of the joints.

Unlike gout, no special dieting is required in these affections. Moderation should be the keynote of all prone to the various forms of fibrositis, and especially should they avoid foods which their experience has taught them to be apt to produce gastro-intestinal fermentation. It is quite unnecessary to prohibit such articles as red meats, sugar, jams, bread, fruit, etc., in the cases of sufferers from the various forms of fibrositis. All these articles of food, if they do not produce indigestion, are perfectly wholesome. It has become of late years a fashionable craze to attribute many of the forms of "chronic rheumatism" to uric acid. That by-product of the human economy has no part or parcel in the production of any of the morbid conditions generally known as "chronic rheumatism."

DIET IN RHEUMATOID ARTHRITIS

The not infrequent mistake of diagnosing rheumatoid arthritis as gout, and the consequent placing of the patient on a restricted and spare diet, has undoubtedly led to the development of severe and incurable forms of the disease. It is essentially a disease that **requires good and nutritious feeding**, and I have seen many cases of rheumatoid arthritis which had gone thoroughly to the bad through the initial error of mistaking the disease for gout, and treating it with a spare diet. The diet should be as liberal and as good as the patient can digest, and animal food should be partaken of freely, though not to the exclusion of vegetables. The exclusion of the red meats, and of such articles as sugar, potatoes, cauliflower, peas and beans, on the assumption that they do harm in rheumatoid arthritis, is, in my opinion, not only unnecessary but is absolutely opposed to the treatment I have adopted and the careful observations I have made, in the dieting of patients suffering from this disease.

A moderate quantity of wine or stout should be taken with lunch and dinner. Any kind of wine that agrees with the patient may be taken; but perhaps a generous red wine, such as Burgundy, is the most suitable. If the tempero-maxillary joints are so much affected as seriously to interfere with mastication it is necessary to give meat in a minced or pounded form. In such cases as much generous liquid nourishment as possible should also be given.

DIET IN DIABETES

CHAPTER XIII

DIET IN DIABETES

By J. Rose Bradford, M.D., F.R.S.

Of recent years the dietetic treatment of diabetes has been recognized to be not quite so simple as it was thought to be formerly, inasmuch as it is now recognized that different varieties of the affection require different dietetic treatment, and that it is not sufficient simply to cut off all carbo-hydrate foods in all cases. Formerly the treatment consisted simply in restricting to as great an extent as possible the intake of carbo-hydrates. It is now recognized that at any rate in some cases it is desirable to allow carefully regulated amounts of carbo-hydrates, even where their ingestion is followed by some increase in the glycosuria, and thus it is often a matter of considerable difficulty to determine what is the most suitable dietetic treatment, especially in some of the more severe forms of the disease. Again, it is somewhat difficult to draw a hard-and-fast line between the different varieties of the malady, and especially with regard to the exact relation of certain forms of intermittent glycosuria to true diabetes.

Intermittent glycosuria is seen in a number of conditions, but the most important variety from a dietetic standpoint is that where the glycosuria occurs in relation to food, the so-called alimentary glycosuria. There are various grades of severity of this affection. In the slighter forms sugar is only present in the urine after a meal containing a large quantity of sugar as such. In others, the glycosuria is present to a moderate extent so long as any considerable quantity of carbo-hydrates is present in the food, but it disappears so soon as these are cut off. In the slighter forms of glycosuria the presence of sugar is the only abnormality in the urine. On the other hand, in the more severe forms where the glycosuria is more persistent, other abnormal substances, and more particularly acetone and diacetic acid, are also present. Three cases merge into those of more severe diabetes where the glycosuria is not only persistent and accompanied by the excretion of acetone diacetic acid and oxybutyric acid, but it is influenced far less by dietetic restrictions. To this group of cases the term composite diabetes has been applied by some, inasmuch as the glycosuria persists to some degree even when the carbo-hydrates are excluded to as great an extent as possible from the food.

It is essential from the point of view of treatment to differentiate between the different forms of diabetes and to attempt to diagnose, so far as is possible, the particular variety that is present. For this purpose observations should be made on the patient to determine whether the glycosuria is only present after the ingestion of an excessive quantity of sugar or carbo-hydrate, or whether it is present with an ordinary mixed diet such as a healthy adult is in the habit of taking, or whether it is still present after the diet has been cut down so as to exclude, either partially or entirely, carbo-hydrate food. These facts can be expressed in another way by saying that the diabetic and the glycosuric vary in their tolerance of carbo-hydrates, or in the degree to which they can metabolize carbo-hydrate food. In severe cases the organism would seem to have lost all power of metabolizing carbo-hydrates and the whole of the ingested carbo-hydrate is excreted. Further, in these cases the non-carbo-hydrate tissues of the body, especially the proteins and also the non-carbo-hydrate constituents of the food, may give rise to the formation of sugar, as such patients excrete large quantities of sugar in the urine at a time when no carbo-hydrate is being ingested. In this severe type of the malady protein disintegration is so great as to lead to a notable increase in the nitrogenous extractives in the urine, particularly the urea, and there is obviously a very complex disturbance of the metabolic processes.

A very important group of cases is that in which a slight trace of sugar is present in the urine from time to time, but where a test meal rich in carbo-hydrate is immediately followed by the excretion of sugar in appreciable quantity. These cases are important because usually they are discovered accidentally in the course of a routine examination, as for instance for life insurance, and although the patients may maintain a condition of good health for long periods, it would seem that a certain proportion of such cases ultimately become diabetic. This type of case is important to recognize and treat, inasmuch as they are very amenable to suitable dietetic treatment, and very commonly only slight restriction in the diet is necessary in order to lead to the disappearance of the glycosuria.

Although it is of the first importance in the dietetic treatment of diabetes for a careful examination of the urine to be made, both from the point of view of the amount of sugar present and its relation to the character of the food, and also to determine the presence or absence of such substances as acetone and diacetic acid, yet attention must not be concentrated exclusively on the urine, and the diet must not be regulated entirely by the effects produced on the urine. Thus a rigid diet may lead to a diminution in the quantity of urine and in the amount of sugar present, and the patient's symptoms, especially his thirst, may be relieved to a greater or less extent. Yet such a patient may not be improving when tested in other ways, and more especially when observations on the body-weight are made at regular intervals. A progressive loss of weight may often be observed where a rigid diet is being given, and yet where the quantity of sugar excreted has diminished as a result. In these cases, however, the serious nature of the disease can often be recognized by the presence of considerable quantities of diacetic acid and oxybutyric acid in the urine. Some amelioration in these severe cases may be often observed as the result of allowing carefully regulated quantities of carbo-hydrates in the food.

The different varieties of diabetes may not only be separated from one another by the differences alluded to above in the composition of the urine and in the degree to which the urine responds to dietetic treatment, but they may also be differentiated by their morbid anatomy and also to some extent by their clinical course. Thus the more severe forms of the disease are commonly associated with lesions of the pancreas, and hence are spoken of as **pancreatic diabetes,** and such cases commonly run an unfavourable course accompanied by much emaciation. A totally different type is that seen in middle-aged obese patients where the quantity of sugar excreted is far less, and where some of the more characteristic features of the disease, such as great thirst, are absent. In these cases of **fat diabetes** the clinical course of the malady is often much more prolonged and less severe. Again, there is a very distinct type seen in middle-aged persons associated with more or less advanced **arterio-sclerosis,** where the amount of sugar excreted is usually small, but where in addition albumin is present, and the clinical course of this variety is very different to that of the other forms of the disease, and such patients are far more liable to complications dependent on the vascular degeneration that is present, e.g. cerebral hæmorrhage, thrombosis, gangrene of the extremities, etc.

It is obvious that these different types of diabetes must necessarily require very different dietetic treatment; thus to take the arterio-sclerotic form of the malady, it is clear that a highly nitrogenous protein diet cannot be partaken of in such cases without very considerable risks being incurred.

In regulating the **dietetic treatment** of this malady many factors have therefore to be taken into consideration. First **the type of the disease** as determined by the age, duration and clinical course of the malady, as for instance on the one hand the severe type seen in young adults characterized by great wasting and the excretion of a very abundant urine containing a very high percentage of sugar, together with acetone and diacetic acid, and on the other hand, the type seen in middle-aged or elderly fat patients where the symptoms are slight and the amount of sugar excreted far less.

The second most important point is the **degree to which the excretion of sugar can be affected by dietetic measures.** In all cases of diabetes, before any treatment is undertaken, medicinal or dietetic, the patient should be put on an ordinary diet, and careful determinations made of the total quantity of sugar passed in the twenty-four hours, together with determinations of the presence or absence of diacetic acid, acetone, etc. When these facts have been ascertained the diet should be gradually restricted until all carbo-hydrates are eliminated from the food. During this period no medicines, such as opium, antipyrin, etc., should be given. When the patient has been given a rigid diet for several days a further analysis of the urine should be made and the quantities of sugar excreted on this rigid diet compared with those passed on an ordinary diet. It will be found that the cases fall into one of three groups: in the majority of instances the sugar will undergo a notable diminution and the daily excretion will fall to half or one-quarter of that previously existent. Together with this fall in the output of sugar there will be a notable improvement in many of the symptoms, especially the thirst. In a certain proportion of cases, more especially where the quantities of sugar voided on the full diet were not large, the rigid diet will lead to a complete disappearance of the glycosuria. Lastly, in a third group of cases the rigid diet produces comparatively little effect on the sugar output and the patient continues to pass large, and sometimes very large quantities of sugar on the most rigid diet that can be devised. These three groups of cases indicate different degrees of severity of the malady, and perhaps in some instances differences in the nature of the lesion. They at any rate indicate very clearly that different dietetic treatment is necessary.

Lastly, the third factor that has to be taken into consideration in the dietetic treatment of the disease is the **influence of the diet on the body-weight.** Observations should also be made on the temperature, as a subnormal temperature is always a danger signal.

Another general principle applicable to all cases of diabetes is that **changes in the diet** in either direction **should be made gradually.** There would seem to be some risk of the production of diabetic coma, so-called acetonæmia, as a result of sudden changes in diet in either direction. Instances of the occurrence of diabetic coma have been known as the result of suddenly putting a patient on an extremely rigid diet, and it is also well known that indulgence in forbidden articles of diet has also been followed by the development of this fatal complication. Although the diabetic is unable to metabolize most forms of carbo-hydrate, this disability is not equally marked with all carbo-hydrates, and lactose and lævulose are less harmful than dextrose. Lævulose is more easily assimilated than lactose, the main objection to its administration in diabetes is the difficulty in obtaining it pure, and it is expensive; but appreciable quantities can be given to many diabetics without its administration being followed by any increase in the glycosuria. Although the diabetic cannot usually metabolize carbo-hydrate material, it is of some interest that if pyrexia occurs as the result of some intercurrent illness complicating diabetes, the excretion of sugar in such a case may undergo a great diminution. This may be seen where diabetes is complicated by even such a prolonged febrile illness as enteric fever, and it would seem that during the pyrexial process the altered metabolism is capable of oxidizing sugar.

I. Where the restricted diet leads to the disappearance of sugar from the urine, as in the well-known so-called **alimentary type of the disease,** the restricted diet should be maintained for prolonged periods, and when the urine has remained free from sugar for some months, small quantities of carbo-hydrate, such as 2 oz. of bread, may be allowed daily. The urine should be tested to see if it remains free from sugar, and if it does the quantities of carbo-hydrate allowed should be gradually increased, the amount given being determined by the effect on the urine. In many of these cases it has been found that as a result of the withholding of carbo-hydrate food for some time the patient has subsequently been able to metabolize at any rate moderate quantities of carbo-hydrates without the development of any glycosuria. The dietetic treatment of these cases presents no great difficulty, although special ways of cooking the food are often necessary, at any rate in the earlier stages of the treatment inasmuch as flour and other carbo-hydrate materials are so constantly used in the cooking of a very large number of articles of diet, e.g. soups, meat, fish and vegetables. The amount of carbo-hydrate allowed in the form of bread or potatoes in this type of case is entirely determined by the effect on the urine.

II. In the second type of case, where **the greatest restriction in the diet leads only to a diminution in the quantity of sugar excreted,** there is considerable difficulty in the successful dietetic treatment of the malady. It is especially in this type of case that harm may be done by adhering too strictly to a carbo-hydrate free diet, and the degree to which carbo-hydrates are allowed must be determined not so much by the amount of sugar present in the urine as by other considerations, such as the general condition of the patient, the state of the body-weight, and the presence or absence of considerable quantities of diacetic acid and oxybutyric acid in the urine. Further, in this type of case the sugar is derived partly from the abnormal metabolism of proteins, and hence it is not advisable to unduly increase, as is so often done, the amount of protein in the diet. In this type of case the patient should be given a diet containing a moderate quantity of meat, fish, and eggs, together with liberal allowance of green vegetables and some bread substitute such as casoid bread. The subsequent course of the case should determine whether carbo-hydrates should be allowed or not. If, as is often the case, the sugar excretion does not fall materially and the patient begins to lose weight progressively, a definite quantity of carbo-hydrate food in the form of bread or potatoes should be ordered. Although in this way the amount of sugar excreted daily may be somewhat increased, the general condition of the patient may improve and the body-weight increase, and further, the quantity of acetone and diacetic acid in the urine undergo diminution.

There is some difference of opinion with reference to the kind of carbo-hydrate that may be given in these cases. Some authorities give definite quantities of ordinary bread, others advise oatmeal, others potatoes. It is not probable that the differences observed with these different carbo-hydrates are due to any inherent differences in the starch, but rather that they depend on the actual quantities of carbo-hydrate in any given quantity of the food-stuff. Thus, roughly, bread contains three times as much carbo-hydrate as potatoes, and hence the patient's desire for carbo-hydrate food can often be more easily satisfied with potato than with bread.

In this type of diabetic, where the excretion of sugar is not prevented but only diminished by a rigid diet, the quantities of carbo-hydrate given must be strictly moderate and kept under supervision.

It is not sufficient for the successful dietetic treatment of these cases to carefully limit or exclude, as the case may be, carbo-hydrate food, but it is most important to encourage as much as possible the taking of fatty food. To supply the energy that is required in the absence of carbo-hydrates, fat should be given to as great an extent as possible in the form of butter, cream, and oil. Considerable quantities of butter may be taken with vegetables and, speaking generally, vegetables that are ordered in cases of diabetes should be cooked with butter or served with butter. Considerable quantities of fat may be also given in the form of salad oil.

III. The third type of case where the **rigid diet leads to but little diminution in the sugar excreted** is a most severe form of the affection, and is that seen more especially in early life. In these cases but little benefit is obtained by rigid dieting, and the treatment should be very similar to that advocated in the second type of case, that is to say, carbo-hydrates may be allowed, the amount given being determined by the state of the nutrition, the body-weight, and the extent to which diacetic acid and similar products are present in the urine. It is especially in this type of case that much harm may be done by sudden changes in the diet, and there can be no question that a rigid diet, if persisted in, may lead to the development of acetonæmia and coma.

In some cases of diabetes renal lesions are present, more especially chronic nephritis and granular kidney. It is difficult to lay down any rules for the dieting of such cases, as with the exception of the glycosuria seen in some forms of arterio-sclerosis, all such cases are of very great severity and but little influenced by treatment. Still, it is usually impossible where renal lesions are present, to diet the patient according to the rules suitable for uncomplicated diabetes, inasmuch as the large quantities of protein suitable for the diabetic are very unsuitable for the treatment of the renal complications. As a rule these cases will require dieting rather from the point of view of the renal lesion than from the mere diabetic standpoint.

Renal disease is not the only complication of diabetes that interferes with the usual dieting necessary. Phthisis occurs frequently as a complication of diabetes, and it is not as a rule advisable to treat such cases with the rigid diet employed in ordinary diabetes.

When it is desired to restrict the input of carbo-hydrates to as great an extent as possible, the food must be limited to meat, fish, green vegetables, nuts, and some bread substitute. Almost all varieties of **meat and fish** are allowable, with the exception of liver, sausages and oysters. Oysters contain a considerable amount of glycogen, and are not thus desirable in cases where extreme rigidity of the diet is advisable, as for example in cases of alimentary glycosuria. The diabetic can take a great variety of **green vegetables,** but peas and beans are usually excluded, inasmuch as these also are much more rich in starch than the ordinary green vegetables. Most blanched vegetables should be forbidden, but celery and asparagus are allowable. Further, rhubarb, tomatoes and cucumber, contain relatively little starch, and thus may be allowed.

One of the great difficulties in the treatment of the disease with rigid diet lies in the fact that in the cooking of food so much carbo-hydrate material in the form of flour is so often used. Many meat and fish dishes are served with sauces containing very considerable quantities of starch. Meat and fish will, therefore, usually have to be roasted, boiled, grilled or baked, and in the case of fish will usually have to be served with butter. The same difficulty applies to a modified extent in the case of vegetables, and it is usually advisable to cook these in butter or to serve them with butter. Meat soups may be allowed in the treatment of the disease, but most vegetable soups are not permissible, as here again they are so frequently thickened with flour.

The diabetic is unable to partake of most **fruits,** as these are rich in carbo-hydrate material, but the amount of sugar in strawberries and gooseberries is very small, and the same remark applies to early oranges, so that these fruits may be taken in great moderation. The diabetic can take nuts freely, except chestnuts, and nuts form a particularly valuable article of diet in these cases, as they are rich in fatty materials.

The main difficulties in the treatment of the severe cases arise from the **restriction in the taking of bread, potatoes and milk.** It is probable that the small quantities of milk required by an adult in tea are not prejudicial, more especially when it is borne in mind that lactose is not such a harmful form of carbo-hydrate as dextrose, and that some diabetics can metabolise lactose. The great difficulty undoubtedly is the substitution of some article in the place of bread. A great variety of substitutes prepared from cocoanut, almond-flour, bran and casein are made by the manufacturers of diabetic articles of diet. Many of the preparations recommended as bread substitutes contain appreciable quantities of starch, and in some of them the amount may be very large. Hence it is always advisable when using a bread substitute to test it for the presence of starch and sugar. In many instances it is advisable to boil the substances with dilute sulphuric acid, neutralize with a caustic alkali, and then test for sugar with Fehling's solution. Much may be done by encouraging these patients to eat nuts as a substitute for bread with the heavier meals such as lunch and dinner, but at breakfast probably one of the bread substitutes will have to be employed. The popular idea that although bread is harmful, toast is harmless, is of course entirely erroneous, and bread should only be allowed when ordered in definite quantities for cases where it is considered desirable to allow a certain quantity of carbo-hydrate. The same remark applies to the use of potatoes. These should only be given in those cases where the food is not going to be restricted so as to exclude all carbo-hydrates. Potatoes and oatmeal are very suitable kinds of carbo-hydrates to give in certain forms of diabetes, inasmuch as it is so usual to take them with large quantities of fat, either in the form of butter with potatoes, or cream with porridge. This form of dieting, however, as already stated, is only suitable to those cases of diabetes where for the reasons given above it is not considered desirable to entirely exclude carbo-hydrates from the food, and there is no reason for thinking that either potatoes or oatmeal contain carbo-hydrates that are less prejudicial to the diabetic than bread and other carbo-hydrate foods. It is merely a question of convenience of administration and percentage amount of carbo-hydrate material present.

There is some difference of opinion with reference to the use of **alcoholic drinks** in the treatment of diabetes. Some authorities consider that all forms of alcohol should be forbidden. Others consider that alcohol may aid in the absorption of fat and, further, that it may to some extent replace sugar. Probably if the patient's appetite is good and the digestion efficient, there is no necessity for ordering alcohol. On the other hand, in some instances where the nutrition is poor and there may be some distaste for food, it may be advisable to order small quantities of alcohol. Malt liquors and sweet wines and liqueurs are, of course, to be avoided, as they contain considerable quantities of sugar as such. Whisky and gin are usually free from sugar and the lighter hocks, Bordeaux and Moselle wines contain very little sugar. Champagne and the stronger wines, such as port and sherries, are unsuitable.

Tea and coffee may be allowed freely, and cocoa specially prepared so as to contain but little starch is also permissible.

There are a large number of articles of food prepared in a special manner so as to be free from starch and sugar that can be obtained from the firms manufacturing diabetic articles of diet. For instance, some of these manufacturers have prepared jams and marmalade for the diabetic which may suit the taste of some patients. As a rule, by care in the selection of the food and by employing special methods of cooking, the diabetic can be provided with a variety of palatable diet.

DIET IN OBESITY

CHAPTER XIV

DIET IN OBESITY

BY EDMUND CAUTLEY, M.D., F.R.C.P.

THE deposition of fat in the body is the result of a food supply in excess of that required to provide for the loss of energy in the production of work, heat, and other metabolic changes constantly taking place in the tissues generally. Obesity, therefore, may depend on an excess of food supply combined with a normal or a diminished energy-loss. Or the food supply may be less than normal, or normal, while the energy-loss is reduced, either in consequence of diminished muscular activity or because of diminished oxidation due to disease. Obesity is spoken of as *exogenous* when metabolism is normal and the fat deposition depends on the disproportion between food and work. It is called *endogenous* when there is no such apparent cause.

It is doubtful whether there is a true endogenous type of obesity, that is, one which depends for its causation on an abnormal cellular activity, a defective protoplasmic metabolism, either inherited or acquired. Experimental observations, on the oxygen consumed and on the total exchange of gases in the obese, do not indicate any diminution of cellular activity. Allowing for the fat, some of these experiments appear to indicate that in the obese tissue-metabolism is even more active. But the estimation of the food supply shows that the calorific requirements and, therefore, the food requirements are less for the obese than the normal individual, that is, their metabolism is less active. This deficiency in metabolic activity is due mainly to mechanical causes. The increased weight of the body leads to decrease in active exertion and diminution of muscular activity. The muscles become weaker and their metabolism is reduced. The superincumbent layer of fat in the panniculus adiposus acts as a conservator of body-heat, still further reducing the metabolism of heat-producing materials. Alcohol encourages obesity for, by its ready oxidation, it is a source of energy and a sparer of fat. The thyroid glands and the sexual organs have been thought to have some influence on the energy-exchange and consumption of fat. Thyroid extract stimulates metabolism, increasing the consumption of oxygen and the excretion of carbonic acid and nitrogen. In myxœdema the adiposity may be the result of thyroid deficiency but, more probably, it depends on the inertia and muscular inactivity. Possibly the obesity which follows on convalescence from infectious disease may be due to deficient oxidation, the result of degenerative changes in the thyroid. This idea is based on the assumption that the gland is stimulated during fever to increased activity, causing increased oxidation and wasting. Here, too, we must bear in mind that during convalescence the diet is liberal and muscular activity is limited.

Similarly, the increased development of fat, in animals and birds which have been castrated, has been ascribed to a reduction in the oxidative activity, whereas it is due more probably to diminished muscular activity, a placid existence and a liberal food supply. The fact that obesity is frequently associated with impotence is no proof that it is the result thereof. Other factors come into play, notably age and inactivity. Monks and nuns are often quoted as illustrative of the influence of the sex organs, but, even assuming that their activities are in abeyance, it is probable that obesity in this class is due to their sedentary life and excess of fattening foods.

Certain types of **morbid obesity** are pathological or associated with degenerative changes. **In children** we sometimes see obesity, signs of degeneracy, a tendency to giantism, early menstruation, premature development of the sex organs, hirsuties, and precocious puberty. Boys assume the "John Bull" or "Infant Hercules" type of figure, with a somewhat feminine aspect in the shape of enlarged mammæ and deficient hair. Girls have an unduly masculine aspect, blotchy skin, bloated cheeks and pendulous mammæ. This blotchy aspect of the skin is absent in simple obesity. Many cases of precocious puberty, obesity and adrenal tumours are associated.

Another type of fatty degeneration has been described under the name of "Lymphatic Infantilism." It is more common in boys than girls. Up to the age of about ten years they develop rapidly and are precocious. Then they grow fat, but not taller. The mammæ enlarge, the energies and testicular development are arrested, and the boy becomes a mere bag of fat.

In older subjects pathological adiposity is seen in chlorotic girls and in the fat anæmics of later life.

Thus we may recognize **three types of obesity.** The first is the plethoric type, characterized by simple obesity, high colour and good circulatory powers. In the second or anæmic type the circulatory powers have failed to a greater or less extent, either as a sequel of the plethoric variety or the result of disease. The third type is purely a pathological and degenerative one which occurs in children. The second type passes into a hydræmic variety in which the circulation still further fails and the tissues are more or less waterlogged.

The **influence of heredity** is very marked in simple obesity. Just as we find a tendency to the prolongation of life to extreme old age in some families, so we may find a constitutional tendency to obesity in others. In quite half the cases such an inherited tendency is present. Some individuals will get fat on a limited diet, whereas others will eat largely of all kinds of food and yet remain thin. The fattening process is not merely a question of diet. In the animal world these inherited tendencies are developed by selective breeding.

Age, sex, temperament, occupation and **climatic conditions** are all factors affecting obesity. A dietary which is sufficient for the needs of the body in a cold climate or during vigorous bodily labour, will prove much too liberal during idleness or in hot weather, and the extra food is liable to be deposited in the tissues as fat. It is quite rare to see a fat agricultural labourer, for his diet is limited and his output of energy large. It is quite common to see a fat brewer's drayman, for his work is comparatively light and his consumption of beer is usually excessive.

In infancy a moderate degree of obesity is natural, for the food supply is good and bodily activity small in the early months of life. Excessive fatness in the breast-fed babe is almost invariably due to an excess of lactose or fat in the milk supply. Sometimes there is an inherited tendency also. Dr. G. A. Sutherland found, in the case of a baby who weighed 28 lb. at seven months of age, that the mother's milk contained 8·2 per cent of lactose. The excess of fat rapidly disappeared after weaning. In bottle-fed infants the diet is generally too rich in fat, from added cream, or in carbo-hydrates due to the addition of some one or other of the proprietary foods, usually a malted preparation. This excessive fatness is regarded by many mothers as a sign of health and strength. As a matter of fact it is distinctly injurious. It predisposes to eczema and other skin diseases, to bronchitis, and to bowing of the legs from the undue weight of the body. These very fat babies seem to have deficient vital resistance and to stand acute disease badly. Another danger is that of acidosis or acetonæmia on the administration of anæsthetics. Some are anæmic and others may show signs of scurvy.

In youth, especially about puberty, a moderate degree of fatness should be present as an indication that the food supply is sufficient for growth as well as nutrition. Undue fatness is generally combined with the hereditary tendency, excessive greediness, eating between meals and a large consumption of sweets. It is more common in girls than boys because of their more sedentary life and the feminine tendency to a general deposit of fat, æsthetically charming in moderation. Yorke-Davis reported the case of a boy, five years old, weighing 117 lb., who was fairly intelligent and ate all day. His parents and their other children were normal. Many similar cases are on record.

In the animal world it is difficult to produce fatness during the period of growth. Calves and lambs are easily kept fat while taking milk, but when they are turned out to live on the ordinary diet of the fields they do not store up fat as a rule, any excess of food being devoted to growth. After full growth has been attained they can be readily fattened if the diet is suitable; so, too, in the human race. Once **full growth is attained,** fat will be deposited if any excessive intake of potential energy in the form of carbon-containing foods is not counterbalanced by the output of kinetic energy in the form of exercise or work. Up to middle age life is active and metabolism correspondingly rapid. **After forty** the adult tends to become less energetic, more placid in his mode of existence, and to put on fat because of the deficient metabolism. This is still more evident in the female than in the male. Increase in age is often accompanied by increase in material prosperity, greater luxury in diet, and reduction in work or exercise. The working-class woman eats more, drinks more, and works less. She is better clothed and takes a tram or 'bus instead of walking. Among the richer classes the tendency of increased prosperity is towards a reduction in the expenditure of energy in moving about, a diet which is certainly no less liberal and nutritious and often more dainty and tempting, and frequently an increased consumption of alcoholic drinks.

People who eat largely and take little exercise without getting fat may be fortunate in that they can indulge freely in the pleasures of the table. The individual with a tendency to obesity must not be tempted to follow such an example and will have to be rigidly careful. Instinct and craving are untrustworthy guides. The digestive, absorptive and assimilative capacities vary very greatly in different subjects, but the final conclusion on the study of obesity is that, with rare exceptions, it is mainly due to an excess in the food supply, and that it is only on these lines it can be successfully treated. The general principles of diet which will now be considered are those appropriate to simple obesity, and must be modified in accordance with the particular patient, the age, the mode of life, and especially in those instances which are pathological in origin or have developed pathological changes. Occasionally it is necessary to reduce the excessive fat quickly. More often it is quite sufficient and much safer to reduce it slowly.

Treatment resolves itself, therefore, into strict limitation of the diet, exclusion or limitation of alcoholic drinks, light clothing and cool rooms, cold bathing, and plenty of exercise. Exercise augments consumption, but it increases appetite and is insufficient, by itself, to counteract excessive eating. The loss of heat from the surface of the body is an adjunct, though not a very powerful one, in the consumption of fat. Finally, having reduced the obesity to reasonable limits, a minimum diet must be established to prevent re-accumulation.

Fat is a carbon mixture. All the food-stuffs, viz., proteins, fats, and carbo-hydrates contain carbon. That fat in the body can be derived from protein in the food is shown by the deposition of fat in carnivorous animals and the fattening properties of nitrogenous foods in the feeding of cattle. In the ripening of cheese some of the protein is converted into fat. Chiefly, however, the fat is derived from the fats and carbo-hydrates in the diet. As a rule, it is the latter rather than the former which are to blame in excessive obesity, but the effects vary in different individuals. The essential feature in the diet is a diminution in the carbon in the food, either in the form of fat or carbo-hydrate. It is not necessary to combine this with an increase in the consumption of proteins. The excess of protein food may lead to ills worse than mere obesity. An excessive protein dietary has been supposed to cause increased oxidation and consumption of fat. There is no reliable proof of this supposition. More probably the wasting of the patient fed on such a diet is due to the deficient supply of carbon-containing food and to disordered metabolism, a pathological rather than a physiological mode of reducing obesity. An increase in the consumption of green vegetable food is advisable, for such foods are comparatively innutritious and by their bulk give a feeling of fullness.

Alcohol should be avoided, for it is a fat-sparer. The malt liquors are particularly unsuitable, for they contain a distinct amount of carbo-hydrate, some of them, e.g. Allsop's lager, cider and champagne perry, in the very considerable amounts of 5 to 11 per cent.

It is obvious that no diet can be at once devised which will suit every patient. We must take into consideration several facts. The weight of the individual varies and his metabolism varies under different conditions of life and environment. The metabolism of different people is variable. The tendency to obesity is not entirely dependent on the food supply. It is quite possible to reduce the supply of carbon-containing foods to a considerable extent and yet to find an actual increase in the obesity, because of improved digestion, absorption and assimilation. Such a result shows that deposition of fat can only take place at a certain rate, and cannot be regulated so as to vary directly with the food supply. Some of these cases of obesity in people on a limited diet have been regarded as morbid, the result of defective metabolism and imperfect oxidation, but they should rather be looked upon as resembling animals who thrive on little food. In the farmyard it is constantly found that some breeds of pigs fatten much more quickly and on much less food than other varieties. Further, we have to consider the effects of age, sex, temperament, occupation, climate and environment.

Hence, each case must be treated on its merits. Primarily it is essential to weigh the patient; to make a thorough physical examination, paying special attention to the circulatory and excretory organs, general health, vigour and absence of disease; to inquire into the family and the past history; and to ascertain carefully the habits as to food, sleep, work and exercise. Examine the urine, for a deficient excretion of urea and uric acid contra-indicates a liberal protein diet. The hereditary cases are the ones which benefit least from dietetic treatment. The self-indulgent individuals of the richer classes are the ones least likely to stick sufficiently long and rigidly to the dietetic restrictions necessary for permanent cure.

There are **two methods of limiting the diet.** In the first, the ordinary daily diet for a week must be weighed and then the quantities of the various constituents, according to which are excessive, must be reduced and the patient weighed weekly. In the second method, the number of calories of heat required for the patient, according to the age, weight and occupation, must be calculated. A diet containing food-stuffs to supply this amount is given for a week, and the amount is then reduced weekly in accordance with the effect on nutrition. It will be necessary to consider the calorific requirements of the normal diet.

I. The **mildest cases of obesity,** namely those of middle-aged men or women who are getting fatter than they care about, can be treated on very simple lines. It may be quite sufficient for the patient to omit sugar from the diet, replacing it by saccharin or saxin for sweetening purposes. The next step is reduction in the amount of bread, potatoes and other starchy foods. Alcoholic drinks should be limited or reduced in amount, and the total amount of fluids should be kept within reasonable limits. The omission of fluids at meal times may be an advantage. Next, the amount of fat taken should be reduced and cream entirely omitted. Finally, white bread can be replaced by the less nutritious wholemeal bread or partly by gluten bread or other anti-diabetic products.

Treatment on these lines is suitable for mild cases in people who can live an open air life, taking plenty of exercise, and not needing supervision; for those who can or must continue their usual avocations; in the presence of any morbid state which renders rapid reduction inadvisable; and as a preparation for more serious methods.

II. The majority of patients who apply for treatment are not satisfied with such simple advice. Though they may realize its value they will not control their appetites sufficiently to carry it out. Some of these can be more strongly influenced by rigid directions as to diet, the nature and amount of each meal, the weighing of the food and the record thereof, the weekly visit to the doctor, and the weekly weighing. Considerable reduction in the amount of fluid should be insisted on at first so that the loss of weight may be considerable and the patient favourably influenced, though the actual reduction in fat is slight. Still more likely are they to carry out directions if they pay in advance an unnecessarily high and inclusive fee for a course of treatment lasting for six weeks to three months or more. Unfortunately, even under these conditions, the favourable results are often merely temporary, for the obese seem much less able than the ordinary individual to resist the pleasures of the table. Most of the special diets are more or less starvation ones.

The calorie value and food requirements of a normal diet.—The calorie value of protein is 4·1, fat 9·3, and carbo-hydrate 4·1 (Rubner) per gramme. More recently Atwater has calculated these values at protein 4·4, fat 9·1, carbo-hydrate 4·1. Rubner's figures are the ones generally adopted. On a basis of these figures 100 grammes of fat are equivalent to 227 grammes of protein or carbo-hydrate.

A man weighing 70 kilos (11 stone) requires 40 calories of heat per kilo, or a total of 2,800 calories. This would be supplied by such diets as:

Calories.	Grms.	Diet.	Grms.	Calories.
410	100	Protein	120	492
837	90	Fat	150	1,395
1,640	400	Carbo-hydrate	170	697
—	—	Alcohol	30	210
2,887				2,794

Rubner has estimated the number of calories required by a man of 70 kilos weight as 32·9 per kilo when resting, and 34·9, 41·0, 48·0, or 68·4 per kilo, according to the increase in the amount of the daily labour; the total number of calories rising from 2,303 to 4,790.

These figures afford a useful basis of computation for the suitable diet of any particular case. Anything beyond this may be stored up as fat, even an extra daily food supply of 200 calories taken in the form of about ½ pint of milk, 1 oz. of butter, 2 of cheese, 3 of bread, 3 or 4 of meat, or ¾ of a pint of beer.

A study of experimental dietaries shows that the food taken daily should supply from 2,500 to 3,000 calories of heat; that in many circumstances a smaller amount is sufficient; that with increased work an increased amount is made use of. The total diet depends on the physique, the work and the result. In applying these facts to a case of obesity the calorie value of the food should be reduced at first by one-fifth, by the omission of sugar and alcohol from the diet and an increase in the exercise taken. By reducing the amount of bread and potato the calorie value can be reduced a further one-fifth. If it is desired to reduce the calorie value three-fifths, to 1,000 to 1,500 per diem, the patient at first must be kept in bed. Chittenden found 1,600 calories sufficient for a man of 57·5 kilos weight, that is, less than 30 calories per kilo of body-weight. As shown above, the number of calories needed per kilo. of body-weight varies with the output of energy of the individual, the external temperature, and other factors.

Certain special diets have been advocated for the **treatment of obesity.** Their description, advantages and drawbacks must be considered carefully before adopting any one of them.

1. **Banting's diet** was devised for him by Dr. Harvey. It consisted of animal food, 13–16 oz.; bread, 2 oz.; fruit and vegetables, 6–12 oz.; total fluid, 35 oz.

9 a.m.	A large cup, 9 oz., of tea without milk or sugar. One oz. of toast or a little biscuit; 4–6 oz. of beef, mutton, kidneys or broiled fish.
2 p.m.	Two or three glasses, 10 oz., of claret, sherry or madeira. One oz. of dry toast; 5–6 oz. of lean meat, poultry, game or fish; any vegetable except potato, parsnip, carrot, turnip or beetroot; unsweetened cooked fruit out of a pudding.
6 p.m.	A large cup of plain tea, 9 oz.; 2 or 3 oz. of cooked fruit, and toast or a rusk or two.
9 p.m.	A glass or two, 7 oz., of claret or sherry and water; 3 or 4 oz. of meat or fish as at dinner.

A glass of grog, without sugar, or a glass or two of claret or sherry was allowed as a nightcap.

Not allowed.—Pork or veal; eels, salmon and herrings; champagne, port and beer; certain vegetables above mentioned.

There is no apparent reason for not allowing veal, its calorie value being little higher than beef and much lower than mutton. According to some analyses the percentages of fat in meats are: veal 16, mutton 5, beef 3. If this is always so veal is the least suitable. The amount varies in all meats with the fatness of the animal or bird. Water is not limited and should be taken in considerable quantities to aid in the elimination of the products of protein metabolism. The excessive amount of protein food throws an unnecessary and serious strain on the kidneys. A prolonged diet of this nature is liable to set up dyspepsia and intestinal disturbance, debility, nervousness, depression and insomnia. Metabolically it is unsound, for an excessively high amount of protein has to be taken and broken up to supply heat and energy, in place of the fat and carbo-hydrate foods which are so strictly limited. Even then only about 1,100 calories of heat are produced, and protein tissue metabolism will prove insufficient and fail. Another objection is the alcohol. It is unnecessary. Unless the wines recommended are of good quality they are liable to impair the digestion and cause rapid loss of weight. Probably, unless there are special indications for its use, it would be better to omit them entirely and allow instead some fat and more carbo-hydrates. Sufficient fat and carbo-hydrate should be given to maintain nitrogenous equilibrium. Then, any increase in the metabolism of non-nitrogenous substances, the result of exercise or cold, etc., would reduce the amount of fat in the body.

2. **Ebstein's diet** is a modification of Banting's, containing more fat and less protein. The carbo-hydrates are much restricted, but a liberal allowance of fat is given on the grounds that it is more satisfying and less fattening.

6–7.30 a.m. . .	Plain tea, 8–9 oz., and 2 oz. of well-toasted bread with plenty of butter.
2 p.m.	Soup, made with beef marrow; fat meat, 4½ to 5½ oz., with fat sauce; green vegetables; fresh fruit; 2 or 3 glasses of a light white wine.
Tea	Same as at breakfast. Or merely a cup of plain tea is allowed after the midday meal.
7.30 p.m. . . .	Tea; one egg; fat roast meat or ham; smoked fish; 1 oz. of bread with plenty of butter; a little cheese; fresh fruit.

About 3 oz. of bread is allowed daily; of vegetables, asparagus, spinach, cabbage and legumes are permitted; potatoes, sugar and sweets are forbidden.

3. **Hirschfeld's diet** is much like Ebstein's, except in containing only half the quantity of fat.

Breakfast. . . .	Plain coffee and 2 oz. of bread.
Forenoon	Two eggs.
Dinner	Soup with 2 oz. of rice, weighed before cooking; 8 oz. of lean meat, boiled or roasted, with a little fat.
Afternoon . . .	Black coffee.
Supper	Cream cheese, 2 oz.; bread, 4 oz.; butter, ½ oz.

4. **Oertel's diet:**

Minimum Diet.	Maximum Diet.
7–8 a.m.—Coffee, 120; milk, 30; 2 soft-boiled eggs or lean meat, 50–100; bread, 25.	This contains the same as the minimum diet and certain additions. Meat, 100; Butter, 12; bread, 35–70.
10–11 a.m.—Clear soup or water, 100, or port wine, 50. Cold meat or lean ham, 50; rye bread, 20.	Or light wine, 100.

Minimum Diet.	Maximum Diet.
1 p.m.—Wine and water, 200; soup, 0–100; roast beef, 150; or beef boiled with fat, 150; green salad, 25; green vegetables, 50; farinaceous pudding, 100; or rye bread, 20; fresh fruit, 100.	Wine, 250. Beef, 50 more. Salad, 25 more. Roll of bread, 25.
4 p.m.—Coffee, 80; milk, 20.	Coffee, 120; milk, 30.
Evening.—Wine, 200 or water, 250; 2 soft-boiled eggs or lean roast meat, 150; salad, 25; rye bread, 20; cheese, 15; fruit, 100.	Wine, 250; water, 100–150; Caviar, 12, or smoked salmon, 18; game, fowl or beef-steak, instead of roast beef, 150.

Note.—The quantities are given in grammes. One ounce is equivalent to 30 grammes. Saccharin is used for sweetening. Fruit is not always allowed. The diet is combined with exercises, active or passive, to strengthen the heart. In fatty accumulation about this organ the amount of liquid, fat and carbo-hydrates in the diet are still more reduced.

5. **Schweninger** modified this diet a little, chiefly in respect of fluids, which he only permitted to be drunk one to two hours after meals, and he allowed more carbo-hydrates, but less fat.

Morning	Tea or coffee, 6 oz., with a little milk; bread, 3 oz.
Noon	Soup, 3–4 oz.; beef, veal, game or poultry, 7–8 oz.; salad or light vegetable; sometimes a little fish cooked without fat; bread, 1 oz.; farinaceous pudding, 1–3 oz.; fresh fruit, 3–6 oz.; light wine, 6–8 oz. (not necessary in cold weather or if fresh fruit is taken).
Afternoon . . .	Tea or coffee, 6 oz.; occasionally bread, 1 oz.
Supper	One or two soft-boiled eggs; bread, 1 oz.; perhaps a small slice of cheese, salad and fruit, wine, 6–8 oz. with water, 4–5 oz.

6. **Schleicher's diet** is on the same lines, but fluid is not absolutely excluded at meals, and more meals are taken.

7 a.m.	Mutton or veal cutlet or a portion of sole, as big as the palm of the hand, and as much bread.
8 a.m.	A cup of tea with sugar.
10.30 a.m. . . .	A sandwich of bread and meat or sausage.
Noon	Meat, eggs, green vegetables, cheese, orange. Two glasses of white wine.
4 p.m.	Tea with sugar.
7 p.m.	A small quantity of bread and cheese.
9 p.m.	Cold meat, eggs, salad, and two glasses of wine.

7. The **Salisbury diet** is sometimes adopted. Towers Smith advocated a diet on these lines, viz., rump steak 3½ lbs., cod-fish 1 lb., and 6 pints daily of hot water for period of two weeks. During the next three weeks the hot water is reduced to 4 pints,

and other kinds of lean meat and fish are allowed, also green vegetables and unsweetened rusks. Subsequently, for months, the diet should consist of hot water 1 pint, crusts of stale bread, captains' biscuits, grilled meat, poultry or game, and hock or claret with seltzer water. Five grains of bicarbonate of potash are given night and morning.

This diet is open to the same objections as the Banting diet. The Salisbury cure is described in the chapter on Special Diets and Diet Cures.

8. **von Noorden** prefers numerous small meals.

8 a.m.	Cold lean meat, 3 oz. ; bread, 1 oz. ; tea or coffee, with a spoonful of milk and no sugar.
10 a.m.	One egg.
12 a.m.	A cupful of strong soup without fat.
1 p.m.	A small plate of clear soup ; lean meat or fish, 5 oz. ; potato, 3½ oz. ; green vegetables ; fresh fruit, 3½ oz.
3 p.m.	A cup of black coffee.
4 p.m.	Fresh fruit, 7 oz.
6 p.m.	A glass of skimmed milk.
8 p.m.	Cold lean meat, 4½ oz., with pickles ; Graham bread, 1 oz. ; 2–3 spoonfuls of fruit cooked without sugar.

Two glasses of wine are allowed daily.

9. **Hoffman's diet** consists of protein and fat, in four meals. Plasmon, nutrose, etc., can be added. Calorie value 2,000–2,500.

1. Milk, 200 ; cream, 50 ; meat, 100 ; 2 eggs, butter.
2. Meat, 200 ; peas and greens.
3. Milk, 200 ; cream, 50.
4. Ham and 4 eggs.

Analysis of Special Diets.

(Amounts are given in grammes.)

	Protein.	Fat.	Carbo-hydrate.	Calories.
Oertel (maximum).	170	45	120	1,608
Hirschfeld (maximum)	139	65	167	1,400
von Noorden	155	28	112	1,366
Ebstein	102	85	47	1,300
Oertel (minimum)	156	25	75	1,180
Banting.	172	8	81	1,100
Hirschfeld (minimum)	100	41	50	1,000

The obvious objection to all these diets lies in the high proportion of protein. Average diets such as those of v. Ranke, Moleschott, and Pettenkofer and Voit contain from·100 to 137 grammes of protein, or 15·5 to 19·5 of nitrogen. Chittenden has shown that in professional men, soldiers and athletes, a diet containing about half the above amounts of protein and nitrogen, or even less, is sufficient to maintain nitrogenous equilibrium. It is, therefore, a most irrational proceeding to give the obese an excess of protein food to provide the calories of heat required. It is much more rational, besides being physiologically sound, to reduce all the different constituents of the diet to such an extent that the relative proportions are maintained, but the calorie value is brought down to 1,500–2,000, or even lower in suitable cases. In order to meet these requirements recourse must be had to a free supply of foods containing very little nutriment, such as the vegetables, and the calorie value of different foods must be studied.

THE CALORIE VALUE OF COMMON FOODS PER OUNCE.

Meat, fish and cereals are cooked. Vegetables are boiled.

0–5.	5–10.	10–20.	20–30.	30–40.	40–50.	50–60
Vegetable marrow	Asparagus	Leeks	Potatoes	Baked beans	Dried peas	Sprats
	Broccoli	Salsify				Salmon
Spinach	Artichoke	Green artichoke	Cherries	Lentils	Whole egg	Herring
Seakale	Broad beans		Prunes			Tunny
Onion		Petit pois	Figs	Macaroni	Mackerel	
Turnip	Green peas	Haricot beans	Grapes	Scotch oatmeal	Brill	Chicken (fricasseed)
Savoy cabbage	Brussel sprouts		Bananas		Lobster (potted)	
		Beetroot (uncooked)				
Cauliflower			Crab (tinned)	Haddock	Crab (potted)	
Parsnip				Gurnet		
Beetroot		Strawberry	Lobster (tinned)	Trout		
Carrot	Water melon	Pine-apple		Roach		
Scarlet runner		Lemon	Smelts	Red mullet		
		Cranberry	Dory	Halibut		
(Uncooked)		Orange	Sole			
Celery		Raspberry	Whiting			
Cucumber		Blackberry	Plaice			
Lettuce		Apricot	Turbot			
Tomato		Apple	Cod			
Radish		Pear	Lemon sole			
		Nectarine				
Butter-milk	Whey					
		Benger's food (cooked)				
		Most farinaceous foods	Tea			Coffee
			Jam	Jam		
			Milk			
		Koumiss				
		Egg-white				
		Hake				

60–70.	70–80.	80–90.	90–100.	100–125.	Over 125.
Breads—	Arrowroot	Sardines	Roast pork	Egg yolk	Bacon (ribs)
Daren	*Breads*—	Roast turkey		Polony	
Manhu	White	Mutton(legs	Brie cheese	Roastmutton	Stilton
Cytos	Bermaline	roast or	Parmesan	Uncooked	cheese
Hovis	Graham	boiled)	cheese	cereals	Neuchatel ,,
Brown		Ham			
	Pork sausage		Currants	Milk	Pea-nuts
Salt herrings	German ,,	Cheese—	(dried)		Sweet
Eels		Dutch	Figs	Cream cheese	almonds
Roast lamb		Camembert	(dried)	Gorgonzola,,	
Roast beef			Filberts	Cheddar ,,	Cocoas
Veal cutlets		Chestnuts		Guyére ,,	Chocolate
Roast veal				Cheshire ,,	
	Toffee	Treacle	Maple sugar	Gloucester ,,	Butter
				American ,,	
				Roquefort ,,	
				Raisins	
				Dates	
				Walnuts	
				Cocoa-nut	
				Cane sugar	
				Beet sugar	
				Honey	

In urgent cases and in fat anæmic women complete rest in bed, milk and massage should be tried. At first skimmed milk is added to the ordinary diet and then finally substituted entirely for it. The quantity is reduced until the patient loses about half a pound daily. The pulse, temperature and weight must be carefully watched and the diet increased, if necessary. The milk cure, really a starvation method, may be adopted (vide p. 175).

Reference to the preceding table enables one to draw up a diet suitable for the obese in quantity and variety and yet not containing an undue proportion of nutritive material. The following dietary may be adopted as a basis, being modified according to the bulk and age of the patient, the mode of life, and the progress of the case.

A Special Diet.

7–7.30 a.m. . . .	One orange, apple or pear. Half a pint of water.
8–8.30 a.m. . . .	Tea, 5–6 oz.; milk, ½ oz.; sweetened with saccharin. One or two boiled or poached eggs. Dry toast or bread, 1–1½ oz.; butter, ¼ oz.
11–11.30 a.m. . .	Clear soup or butter-milk, 8–10 oz.
1–1.30 p.m. . . .	Cold fowl, game, lean meats, ham or tongue, or hot lamb cutlet or sweetbread, 3–4 oz.; salad, 1 oz.; Dutch cheese, ¼ oz.; celery, radishes, etc.; rye, brown, bran or gluten bread, ½ to 1 oz.; butter, ½ oz.; fresh fruit or water, 4–6 oz.

4.40 p.m. . . . A large cup of plain tea, with a dessertspoonful of milk ; one piece of dry toast or bread and jam, or eaten with lettuce, mustard and cress, or tomato.

7.30 p.m. . . . Clear soup, 4 oz. ; fish, cooked without butter, or any kind of meat, game or poultry, except pork, 4–6 oz. ; green vegetables, of a calorie value not exceeding 5 per oz., ad lib., or smaller amounts of those with a higher calorific value, say 1–2 oz. ; farinaceous pudding, 3–4 oz. ; water melon or the cooked unsweetened fruit out of a tart ; dry toast or various breads, 1 oz.; butter, ¼ oz. ; water, 4–6 oz. ; a glass of hot water at bed-time.

If white bread is used in the above diet, the calorie value will vary from a minimum of about 1,100 to a maximum of about 1,500. The chief protein-containing foods are rather high, varying between 8½ and 10½ oz. (240–300 grammes). Ranke gives as a normal diet, meat 240, fat 100, bread 400, water 300–400 grammes. This is a very simple diet, supplying between 2,000 and 2,500 calories. It is easy to regulate, for the quantities can be reduced at will, but its sameness renders it unpalatable after a short time.

On the whole it is advisable to make use of the diet above recommended, as a start. Grilled fish can take the place of eggs. If N-excretion is defective, if the patient is not fond of meat or can do with less, or if satisfied with a more vegetarian diet, the meat can be reduced in quantity at the evening meal and altogether omitted with advantage at the midday meal, and a liberal helping of cooked string beans, celery, onions, cabbage and such like, be given instead. It is important to remember that the nutritive value of vegetables depends greatly on the system of cooking. It is lowest when they are boiled and the fluid in which they are cooked is drained away. This applies especially to the tubers, many of which are rich in carbo-hydrates, which are dissolved out by hot water or weak saline fluids. Fats and carbo-hydrates can be allowed more liberally to the plethoric than in anæmic and hydræmic patients.

General directions must be given **to each patient.** No sugar should be used ; even an ordinary lump has a calorie value of 15–20. Food should be masticated very slowly. This ensures thorough insalivation and is especially necessary to render cellulose foods digestible. It has the further and important effect of considerably reducing the appetite and encouraging a taste for the simpler foods. In choosing the particular articles of food, those should be avoided which contain much fat, e.g. eels, salmon, lobster, crab, sardines, herrings and mackerel among fish and crustacea; pork and goose, and fat meats among flesh foods; nuts and fats, such as butter, cream, olive oil. Potatoes should be omitted, or taken in very small quantities. Milk must not be used as a drink. Most fresh fruits, except bananas, can be taken in moderation, and many of the green vegetables in large quantities. The *ligamentum nuchae* of the ox is recommended by Sternberg as an additional food which is appetising, filling and innutritious. It should be boiled in saline solution until quite soft, minced very finely and dried into a fine grey powder, which can be made up into tablets or small loaves. Many anti-diabetic foods are also of value. Meals should be small and numerous.

For a few days it is advisable to weigh the different articles of food, but after that an intelligent individual can estimate sufficiently accurately what are the quantities ordered of meat, bread, etc. Rigid accuracy is not essential, for the conditions of life vary from hour to hour and day by day. It is best to keep to a simple diet, with comparatively little variety, for variety is a stimulant to appetite.

Clear soups are unnecessary and innutritious, but may be taken fairly often; so, too, plain tea and coffee. Their stimulating effects are often useful, provided there is no contra-indication to the taking of purins. In a few instances, though expensive, it may be possible to estimate and establish nitrogenous equilibrium and then regulate the amount of fat and carbo-hydrate foods. The calorie value of the diet can be reduced to one half without causing any material increase in N-excretion. The reduction in the diet must be combined with exercise to maintain the nutrition of protein tissues.

The minimum amount of nitrogen required in food should be three to four times the amount excreted during hunger. But a minimum amount is not desirable, as it leaves no store for emergencies, and protein tissues are only built up slowly. In addition, the protein foods contain phosphorus and sulphur salts which are essential. Fat, carbo-hydrates and gelatin are protein sparers. Hence a diet liberal in these constituents need only contain a minimum, or slightly greater amount of protein.

The methods of computation of food requirements are based on the percentage composition of the various foods or on their calorie value per ounce. Irving Fisher has recently devised a new system in which he takes a unit of food value, called a standard portion, of each kind of food. This standard portion is the amount of the particular food which will yield 100 calories. Thus, on a basis of 3·3 per cent of protein in milk a standard portion of milk is 4·9 fluid oz. and of the 100 calories in it 19 are from protein, 52 fat, and 28 carbo-hydrate. By comparison, nuts contain 11 per cent of protein, but ½ oz. of nuts forms a standard portion and the calorie-protein in it is only six. Fisher has drawn up tables of the calorie values of the protein, fat and carbo-hydrate of standard portions of different foods and has devised a diagrammatic map of these foods and their values.

Fluids and alcoholic drinks.—Dancel devised a diet in which the amount of fluid ingested was much reduced, on the assumption that excess of fluid increased corpulence. He only allowed from 6–12 oz., gave purges, ordered much exercise, and abstinence from fatty and farinaceous foods. There is no doubt that the amount of fluid should be limited, but not very rigidly. Limitation does not affect the metabolism of fat. The interdiction of fluid at meal times leads to less food being taken, because mastication takes longer and the patient is more easily satisfied. It may impair appetite unduly. Liquids with food dilute gastric juice and may affect protein digestion. From 1½ to 3 pints may be allowed in twenty-four hours, and it should be reduced to the smaller amount, if possible without injury. Small quantities at meals and a glassful night and morning are satisfactory amounts. The quantity must not be unduly reduced if the weather is hot and there is much sweating, or if a large amount of protein food is taken. Strict limitation is valuable if the circulation is feeble in chlorotic and hydræmic cases, and for the sake of the mental effects at the commencement of treatment. Saline, alkaline and effervescent drinks, unsweetened; hot weak china tea, coffee;

and occasionally cocoa, are admissible drinks. Alcohol should not be given unless there are special indications, such as an enfeebled circulation and general debility. It is a fat sparer, causes deficient oxidation and favours fatty degeneration of protein tissues. Dry hock, Moselle and claret are the most suitable wines. Sweet wines and malt liquors are not permitted, and spirits in only small quantities.

Subsidiary methods.—Saline cathartics and the aperient waters of various health resorts, such as Kissingen, Homburg, Marienbad and Carlsbad, act chiefly as starvation cures. They are often useful at the beginning of treatment in plethoric patients. Many of these keep well for years on an annual course of spa-treatment. The peptones and fats are evacuated before full absorption has had time to take place. Unfortunately the effects are rarely more than temporary, for the patient feels weakened by the drain on the system, is often sent to a bracing place to recover, and builds himself up with a liberal diet. In the hydræmic cases, kept in bed, moderate purgation is useful.

Bed treatment is essential in the hydræmic patients, in many anæmic ones, and when the calorie value of the diet is suddenly much reduced, especially in the milk cure. Estimations of the number of red cells, the hæmoglobin and the specific gravity of the blood serum will assist in the diagnosis of the progress of the case. Thyroid treatment is only justifiable when there is evidence of myxœdema. It may cause toxic symptoms. On account of it increasing N-excretion, it is dangerous except as a temporary measure. It should never be relied on as a substitute for diet.

Proprietary remedies.—There is no drug which will reduce the body-weight except by its effects on metabolism, usually acting by impairing the functions of the digestive organs. The expensive remedies advertised for the cure of obesity are useless and generally harmless, unless they upset the digestion. An immediate reduction in weight is not guaranteed, and it is often stated that no marked loss will occur for two to four weeks. In fact the treatment must be prolonged in order to benefit the proprietor. Fortunately thyroid extract is not used, its dangers are too great for even the most reckless advertiser. For some reason or other the bladder-wrack or common seaweed (*fucus vesiculosus*) has a great reputation and enters into the composition of several specifics. It may be given in doses of 3 to 6 drachms daily of the liquid extract, or grs. x–xxx of the extract. Cases have been reported in which it has proved beneficial and harmless. Citric acid is frequently used, perhaps because of the popular idea that lemons, vinegar and acid substances generally, prevent obesity. Sulphur and iodide of potassium are often used. The composition of many of these specifics and their value have been estimated with the following results (*British Medical Journal*, 1907):

1. Absorbit Reducing Paste and Zobeide are used by inunction and contain five per cent of ox-bile: price 3*s*. 6*d*. per 2 oz. jar; value 3*d*. Amiral soap is a similar substance.

2. Allan's Anti-fat contains potassium iodide, grs. 0·3, salicylic acid, gr. 1, and 70 minims of bladder-wrack in each fluid ounce: price 6*s*. 6*d*. for a bottle of $6\frac{1}{2}$ oz.; value 3*d*.

3. Antipon consists of citric acid, grs. 40 to the oz.; dose $\frac{1}{2}$ oz. three times a day: price 2*s*. 6*d*. a bottle of $6\frac{1}{2}$ oz.; value $1\frac{1}{2}$*d*.

4. Mrs. Frost's Anti-Obesity Remedy is an extract of bladder-wrack (Hutchison).

5. Grey's Specific contains 47 per cent of sulphur (Hutchison).

6. Hargreave's Reducing Wafers consist chiefly of fucus: price 1*s*. $1\frac{1}{2}$*d*. for 21; one to be taken three times a day.

7. Hughes and Hughes's XL Reducing Lotion is for outward application and contains iodide, bromide and chloride of potassium; price 4*s*. 6*d*. for $2\frac{1}{4}$ oz.; value $\frac{3}{4}$*d*.

8. Hughes and Hughes's Reducing XL Pills contain potassium iodide, iron and fucus, two to be taken twice a day; price 2*s*. 9*d*. for 28; value $1\frac{1}{4}$*d*.

9. J. Z. Obesity Tablets contain 24 per cent of sulphur; price 2*s*. for 25; value $\frac{1}{2}$*d*.

10. Russell's Anti-Corpulent Preparation consists of citric acid, grs. 37 to the ounce, dose $\frac{1}{2}$ oz. three times daily: price 6*s*. for a $12\frac{1}{2}$ oz. bottle; value 2*d*. The pink tablets are made of saccharin.

11. Trilene Tablets contain bladder-wrack 3 parts, starch 7, and sugar 87 in 100, dose three times daily : price 2*s*. 6*d*. for 66, value $\frac{1}{40}$*d*.

Of course it is impossible to be absolutely accurate in the analyses of preparations which may contain vegetable substances, but the above results are sufficiently reliable.

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DIET IN ARTERIO-SCLEROSIS

CHAPTER XV

DIET IN ARTERIO-SCLEROSIS

By Harry Campbell, M.D., F.R.C.P.

Arterio-Sclerosis is a term used to signify a thickening of the arterial wall, from whatever cause arising. It may occur in either a focal or a diffuse form.

In the **focal form** it is known as atheroma. This begins as a cellular infiltration of the subendothelial portion of the intima; the cells undergo fatty degeneration, and often the patch becomes infiltrated with lime salts. By the running together of several such patches the condition known as endarteritis deformans is produced.

Concerning the pathology of atheroma we know next to nothing. It was once thought to be due to the obliteration of the vasa vasorum, but Cowan has shown this view to be incorrect. One factor in its causation stands out, i.e. protracted high blood pressure. Except as a senile change it is, indeed, rarely met with in subjects displaying low blood pressure.

The **diffuse form** of arterio-sclerosis differs from atheroma in that it involves the entire circumference, and considerable portions of the length, of the vessel. Though it includes several distinct varieties, such as syphilitic endarteritis, the term for most physicians connotes a generalized thickening of the systemic arteries, either in consequence of a primary calcareous infiltration—some would not include this condition under the meaning of the word—or an increase in the actual tissue of the vessel wall. This increase involves essentially the muscular media. When the media only is affected we have the arterial hypermyotrophy of Savill: in the majority of cases, however, the intima is thickened; less frequently, the adventitia.

Though we are still very ignorant of the pathology of arterio-sclerosis, this much can be postulated of it: it is essentially due to the action of some poison, or poisons, circulating in the blood-plasma. These poisons may lead to vascular thickening in one of two ways: either directly, by causing irritative hyperplasia of the fibrous elements of the vessel wall, or indirectly, by inducing arterial hypertonus. This hypertonus involves the systemic arterioles chiefly, though it tends to implicate the entire systemic arterial tree, and, if long continued, necessarily leads to hypertrophy of the muscular media. In some cases the structural changes in the vessel wall would appear to stop here; generally, however, other changes ensue as the result of the vascular strain which is the inevitable outcome of the hypertonus, for it is obvious that the contraction of the minute arteries must send up the blood pressure in the arteries proximal to them. The strain will necessarily be felt chiefly by the media—one of the chief functions of which, indeed, is by its active contraction to resist the distensile effect of the blood pressure on the vessel wall—and by the intima, which in consequence of the pressure to which it is subjected not only thickens but tends to undergo atheromatous degeneration. The adventitia, on the other hand, protected as it usually is from the distensile pressure of the blood by the actively contracting media, may remain for the most part unchanged, even with long-continued hypertonus. It has to be remembered, however, that systemic hypertonus is rarely, if ever, quite general,[1] and that when, with a widespread systemic hypertonus, certain of the arteries remain comparatively relaxed, the adventitia of those arteries will, owing to the heightened blood pressure, be subjected to considerable stretching of a

[1] It is noteworthy that in the cases of diffuse arterio-sclerosis examined by William Russell, the muscular coat of the intra-renal arteries showed evidence of atrophy. From this we may conclude that these vessels do not share in the generalized arterial hypertonus so frequently met with in this condition, but remain, on the contrary, dilated. Such an arrangement secures a maximum supply of blood to the kidneys, for with the augmented systemic blood pressure there is diminished vascular resistance in the kidneys which, being thus abundantly flushed with blood, are so much the better able to eliminate the poisons the presence of which in the blood is the *fons et origo* of the arterial phenomenon under consideration. We have here, in fact, the *raison d'être* of the hypertonus and high blood pressure met with in arterio-sclerosis.

rhythmic character, and will tend in consequence to undergo fibrous hyperplasia.

While insisting on this factor of strain in the production of intimal and adventitial thickening, we are not, of course, overlooking the direct irritative effect on the vessel wall of morbid blood-plasma. That this may be an important factor in the etiology of arterio-sclerosis is abundantly shown by the fact that it is possible to get a widespread arterial thickening in subjects of comparatively low blood pressure. That, however, profound changes in the vessel wall necessarily result from the strain of long-continued high blood pressure is certain, and this, it need scarcely be said, is a fact of great therapeutic importance : practically speaking, there is but one cause of supernormal blood-pressure, namely, arteriolar hypertonus, and again but one cause of sustained hypertonus, namely, some plasmic defect. Wherefore it is manifest that in cases of arterial thickening, whether occurring in connexion with hypertonus or independently of it, our aim is to correct the morbid condition of the plasma which is responsible for the thickening.

In each class of case the dietetic indications are the same, but it is easier to test the efficacy of our treatment when hypertonus is present than when it is absent, seeing that our success in the former case is in direct proportion to the degree to which we can reduce the hypertonus, and this, happily, we now have ample means of gauging.

While there is no doubt that **arterio-sclerosis is essentially due to a morbid blood state,** we have still much to learn regarding the exact plasmic defects capable of producing it. Two classes of defect, however, stand out prominently in this connexion—those which occur in association with **chronic renal disease** and those which result from **dietetic errors.** It is because the constitution of the blood-plasma, and through it the condition of the blood-vessels, can be profoundly influenced by regulating the diet, that the dietetic treatment of arterio-sclerosis is of prime importance.

That arterial hypertonus may be the result of dietetic errors there can be no doubt. The latter may operate in one of two ways : by causing the blood to be poisoned by **the products of**

disordered digestion, and (when too much food is taken) by burdening the tissues with an **excess of nutrient material.**

When, as the result of defective digestion in the stomach or bowel, the blood is contaminated by the absorption of poisons from the digestive tract, the condition may be spoken of as **indigestion toxæmia,** and seeing that the chemistry of indigestion differs for each of its multitudinous varieties, it is obvious that there must be many different varieties of this kind of toxæmia. Of the numerous poisons with which the blood may in this way be contaminated some exercise a *hypo*tonic, others a *hyper*tonic, or constrictory, effect upon the arteries.

There can be no doubt that these vaso-constrictor poisons play a prominent part in the production of arterio-sclerosis. Russell, indeed, contends that they are responsible for most cases occurring independently of chronic renal disease, an association which gives to indigestion, "especially when associated with constipation, a significance which has not commonly been appreciated." The poisons most pernicious in this respect are, according to this authority, those resulting from the **putrefaction of animal protein,** a process which in his opinion is greatly favoured by constipation. Hence, in order to guard against that hypertonus which is the central feature in a large number of cases of arterio-sclerosis, the paramount importance of avoiding an excess of animal food and of securing a free daily evacuation of the bowels must be realized. Vegetable protein and carbohydrates he deems far less capable of inducing hypertonus than animal protein.

The **personal factor** has, of course, to be taken into account in this connexion, for, as Russell rightly insists, "If the big feeder and moderate drinker has a good digestion and free bowel evacuation daily, he may not develop arterio-sclerosis until late in life, while if the spare feeder and teetotaller is a dyspeptic or the victim of chronic constipation, he will suffer from premature arterial degeneration."

While emphasizing the prominent part played by indigestion toxæmia in the production of arterial hypertonus and the associated sclerosis, we venture to think that Dr. Russell attributes to it a too exclusive influence in this direction, and that, apart from renal disease, there are many species of morbid plasma capable of inducing protracted hypertonus besides those associated with diet and indigestion. Nor do we share his extreme views as to the rôle of animal as against vegetable food in the production of this condition. On the one hand we meet with persons who, although eating freely of animal food and habitually suffering from indigestion and constipation, yet exhibit quite low blood pressure readings; and, on the other hand, we encounter, independently of renal disease, instances of protracted hypertonus among persons who consume little animal food, who do not suffer from constipation, and who, to all appearances, seem to digest their food quite well—nay, whose blood pressure continues high during complete starvation.

In considering the effect of diet on vascular tonus we must assuredly take account of the vegetable as well as of the animal food. There is no reason to suppose that the behaviour of vegetable protein in the body differs essentially from that of animal protein. Nor can we exonerate the carbo-hydrates from all share in the production of hypertonus. They are, as is well known, a fruitful source of indigestion, and may, in this way, cause toxæmia, and so hypertonus; possibly also by giving rise to that condition of the blood which Dr. Francis Hare has termed hyperpyræmia. In any case gouty conditions can often be benefited by curtailing the supply of starch and sugar, and although, as Sir Clifford Allbutt and others have rightly insisted, there is not necessarily a rise of blood-pressure in gout, yet there often is, and as a matter of fact it is almost as important to pay attention to the carbo-hydrates as to the animal food in the treatment of high blood pressure due to dietetic causes. In treating hypertonus we may sometimes get better results from a highly animalized diet into which starch and sugar enter but sparingly than from a purely vegetarian diet, always providing that **the total quantity of food is moderate.** Moderation in diet is, indeed, a prime essential in the treatment of high blood pressure, not only because it favours efficient digestion and thus tends to minimize the danger of indigestion toxæmia, but because the tissues are less likely to be clogged with waste products on a moderate diet than on one which is excessive.

In obstinate forms of hypertonus it may be advisable to put the patient on a **milk diet.** This treatment, especially if conjoined with rest in bed, bleeding, and free purgation with mercurials and salines, constitutes the most efficient means of reducing a dangerously high tension. Milk diet is, however, apt to pall after a time; so also is a milk and farinaceous, or milk, farinaceous, and fish diet; and we may find that we get better results from an ordinary diet, if it is relished, than from any of these, always providing that it is moderate in quantity. It is possible that fish is less conducive to hypertonus than bird or butcher's meat. Some maintain that boiled meat is less objectional in this respect than roast, containing as it does a smaller quantity of extractives. For a similar reason soups are by some supposed to be contra-indicated in subjects of high blood pressure.

As regards liquors, **alcoholic drinks** should be either entirely avoided or taken very sparingly. It has been definitely proved that their immoderate use is a potent cause of arterio-sclerosis, as well as of fatty degeneration of the heart. It may not be unfitting to mention here that tobacco smoking tends to cause arterial hypertonus.

Water is the best drink for the subjects of high blood pressure. It should be moderately soft or distilled, and non-aerated. Weak China tea, unsweetened, may also be allowed. In some cases it may be necessary, especially in women, to increase the daily allowance of fluid; in others it may be advisable to reduce the quantity. The patient should not drink much with his meals but should take most of his drink on an empty stomach, about an hour before meal time, so as to allow the fluid to be absorbed into the blood before a fresh supply of food enters the stomach. This plan not only conduces to good digestion by preventing an undue dilution of the gastric juices, but allows any excess of fluid that may be absorbed to be eliminated from the body before a fresh meal passes into the blood.

How far calcification of the arteries can be averted by dietetic measures is, as Sir Clifford Allbutt has said, a contestable point: "In the first place calcification of the media is not 'arterio-sclerosis' in the usual sense of this name . . . ; secondly, I do not know that if the media has entered upon the stage of necrosis leading to calcification this change is any further detriment. Indeed, Ludwig Weil's experiments indicate that thereby the vessel is even fortified. In any case, to try to prevent it by niggling at the lime in the food is like taking away a man's cash and leaving him his cheque-book."

Inasmuch as in certain affections of the kidney, notably Bright's disease, there is an undue retention of chlorides in the system, the question suggests itself whether it may not be possible to reduce a supernormal blood pressure by means of **a saltless diet.** All that we can say at present is that this plan of treatment appears worthy of trial.

Summary.—By arterio-sclerosis is meant either atheroma or a diffuse thickening of the arterial wall. Setting aside primary calcareous infiltration of the media, which is essentially a senile change, most cases of diffuse arterial sclerosis centre round arterial hypertonus. This latter, when protracted, indicates a morbid condition of the plasma and one which, if long continued, will certainly lead to arterio-sclerosis. Hence the importance of recognizing hypertonus early. Just so far as we succeed in relieving the hypertonus, and so far only, shall we be successful in preventing or checking the occurrence of arterio-sclerosis.

There are probably many morbid conditions of the plasma capable of causing hypertonus. One of the most familiar is that which occurs in association with granular kidney. Over-eating and indigestion may also operate powerfully in the same direction, and hence, by careful attention to diet much may be done to guard against arterio-sclerosis.

Accordingly, when this condition is present we prescribe a diet which is easily digestible and no more than sufficient to meet the demands of nutrition, our object being to secure sound digestion and to avoid burdening the tissues with an excess of nutriment. Hence our advice to the subject of hypertonus practically amounts to this : "Eat in strict moderation whatever plain food you are capable of digesting easily." If this advice is stringently followed the patient is not likely to harm himself with animal food. We should, however, always inquire into the exact amount of animal food taken, and be careful to keep its supply within due limits. On the other hand, we may find it needful to curtail the quantity of starch and sugar.

There can be no doubt that by suitably dieting subjects of high blood pressure much may often be done to reduce the pressure to within normal limits, and that, provided treatment is begun sufficiently early, we may in this way prevent the occurrence of arterio-sclerosis. Sir Clifford Allbutt, Dr. William Russell, and Dr. George Oliver are emphatic on this head.

DIET IN DISEASES OF THE STOMACH

CHAPTER XVI

DIET IN DISEASES OF THE STOMACH

By Herbert P. Hawkins, M.D., F.R.C.P.

General considerations.—The prescription of a diet in gastric disorder has a scientific basis. In the first place there is required a knowledge of the whole process of digestion and absorption in health. It must be realized that digestion and absorption are chiefly effected in the intestine, and that the functions of the stomach are to prepare the food for intestinal digestion and in some degree to disinfect it. For the performance of these functions food must enter the stomach suitably cooked, and thoroughly divided and mixed with saliva. These elementary points should be impressed on all patients. It is important to remember that scarcely any absorption takes place in the stomach, only alcohol, small amounts of sugar, dextrin, albumoses and salts being taken up, but little or no water. In many cases of impaired gastric digestion, such as chronic gastritis, gastrectasis, and carcinoma of the stomach, it would be extremely useful if we could increase the amount of nutriment absorbed in the stomach. Very little, however, can be effected in this direction. But in most of these conditions intestinal digestion still has its full value, and it is wise, therefore, to aim at giving such food as will be most quickly discharged from the stomach into the duodenum. Only in pyloric obstruction is the increase of absorption in the stomach a real necessity.

In the second place it is necessary to have a knowledge of the secretory, motor, absorptive and sensory powers of the stomach in the particular diseased condition which is under treatment. Opportunities for actual inspection of diseased stomachs are rare, but from a chemical examination of the contents, from estimation of the size of the stomach (preferably by CO_2 distension), and from a study of all sources it is possible in most cases to gain a fairly clear idea of the state of the stomach-wall in all its elements. For practical purposes the secretion of hydrochloric acid may be taken as an index of the total secretory power. Of this secretion there may be an excess or a deficiency, and both these alterations can be met with appropriate food. As regards the treatment of an insufficiency of motor power, the mode of preparation is nearly as important as the choice of food. In such conditions the consistence of the food must be considered with the idea of ensuring a quick emptying of the stomach. The sensory power of the stomach requires no estimation. If it is normal, it is not considered. If it is abnormal, it is obtrusive and will not be concealed. Thus in some cases of gastric disorder not necessarily severe in themselves, a secondary hyperæsthesia of the gastric mucosa is engendered. In prescribing a diet we are then hampered by the fact that even easily digested foods produce pain and sometimes vomiting upon their entrance into the stomach. The normal unconsciousness of digestion is lost and it is hard to restore. In neurasthenia the task may be hopeless, unless the general condition can be improved. This hyperæsthetic state or nervous dyspepsia may develop without any previous illness. The patient, commonly a female, may have reduced herself to a small liquid diet barely sufficient to sustain life although the functions of the stomach are adequately performed. It may be necessary in some cases to resort to enforced administration of food (cp. Diseases of the Nervous System).

The causation also must be appreciated if dietetic treatment is to be complete. The common disorders of the stomach are mostly self-inflicted, and it is quite as important to correct all vices of eating, diet and life as to cure their results. Excess of food and drink, improper food, imperfect mastication through defective teeth or hurry, and a general tendency to quick meals and immediate movement thereafter, play a large part in gastric disturbance. A routine examination of the teeth should always be made. I doubt if the importance of good teeth and a clean mouth is sufficiently recognized. With reference to excess of food and improper food, a preliminary stage of starvation is the first necessity in the treatment of many cases of gastric disorder.

To miss an occasional meal or to pass one day in seven on a meagre diet is good for many people of leisure. Above all it is necessary to estimate correctly the actual amount of food that is being consumed daily by patients after middle life. The nutritional requirements lessen progressively with increasing years, but the appetite is not necessarily adjusted to this decline, or, if it is so adjusted, custom and example prevail and in spite of diminishing appetite the diet of robust middle life is maintained. Sometimes it will be found that the gastric symptoms of an elderly patient depend entirely on this persistence in the habits of his youth. Sometimes, on the other hand, an old and reluctant patient, who has naturally made the necessary change in his diet proportionate to his age, is brought before a physician by over-zealous relatives on the ground that he is eating nothing. For an old man who has done his life's work a supply of 15 calories per pound of body-weight is an ample allowance.

Beyond this point empiricism begins. All articles of food have been divided by Leube into groups of digestibility by the ascertained times within which they leave the stomach in health. This test of digestibility is not a complete guide in the choice of food, as it is concerned chiefly with the motor power of the stomach, and it does not take fully into account the state of the secretory function. Such a grouping, however, may be utilized in framing a diet, but experience shows that it is not entirely applicable to states of disease. Moreover modifications and allowances must be made for the likes and dislikes of patients. These idiosyncrasies are real but they cannot be foretold, and it is never wise to give a rigid diet to a patient without some discussion of details. All diet-lists are merely suggestive, and as regards both kind of food and amount of food they must be adapted to the patient.

Complete rest lying down after meals is, I think, beneficial in all forms of gastric disorder. It is absolutely necessary in all conditions of diminished motor and secretory power, especially in gastrectasis and gastroptosis. I think it is of equal service in hyperacidity, although there is experimental evidence to show that in health the acidity of the stomach-contents is greater at rest than during movement. Sleep, however, should not be permitted.

Examination of the contents of the stomach must be made when possible. A few simple tests are at the command of all. Vomit may sometimes be used for the purpose, but a test-meal is generally necessary. In ordinary practice Ewald's test-breakfast is most suitable, as it involves little discomfort. It consists of 1⅓ oz. of white bread with 10 oz. of water or weak tea without milk or sugar. In this every class of food is represented, viz: protein, starch, sugar, fat, non-nitrogenous extractives and salts. It should be given in the early morning on an empty stomach, and the residuum should be removed exactly one hour later. The contents of the stomach should then be from 20 to 40 c.c. of clear yellowish fluid when filtered. This test-meal is especially useful when the question of the presence or absence of free hydrochloric acid arises.

For the settlement of questions of delayed digestion and of hyperacidity Riegel's test-meal is more trustworthy. It consists of 12 oz. of soup, 5 oz. of beef, 1½ oz. of mashed potato and a roll, with 8 oz. of water. It should be taken at midday fasting, and after it the patient should remain at rest. Five hours later the contents of the stomach should be acid, and peptones are present with some undigested muscle and starch. Seven hours after this meal the stomach should be empty or contain a little neutral liquid.

The fluid removed after the test-breakfast should be acid. It should show free hydrochloric acid but no lactic acid, and the total acidity should be between 40 and 60 on Ewald's scale (cp. later). It should contain peptone and sugar, pepsin and rennin, but no starch or erythrodextrin.

The reaction may be tested with litmus paper, which is reddened by acid, free or in combination. That the acid is free, is shown if Congo paper is rendered blue or violet (filter paper saturated with a watery solution of Congo red 1–1,000 and dried). But this alteration is produced both by free hydrochloric acid and by organic acids, and the further test of Töpfer and Günzburg is necessary to distinguish between them.

Töpfer's dimethyl-amido-azo-benzol test. A few drops of a 0·05 per cent solution of this substance in alcohol gives a cherry-red colour to the filtrate or even to the unfiltered stomach-contents if free hydrochloric acid is present. A yellow colour is produced in the absence of free hydrochloric acid. It is true that a red colour is produced if as much as 0·2 per cent of lactic acid is present, but this amount of organic acid is rarely found and the test is generally efficient, and certainly easy.

Günzburg's test requires more care. A few drops of the filtrate are evaporated slowly in a porcelain dish with a few drops of Günzburg's solution (vanillin 1, phloroglucin 2, absolute alcohol 30 parts). As it nears dryness, a red colour quickly appears along the edge. The evaporation must be slow, and care must be taken to avoid charring. This test will demonstrate 0·05 per cent of free hydrochloric acid and it is not given by organic acids.

The presence of lactic acid, which is the organic acid of most common occurrence, may be shown by Uffelmann's test. If lactic acid above 0·01 per cent is present, the addition of a few drops of the filtrate will change the blue colour of Uffelmann's solution (carbolic acid 5 per cent 10 c.c., water 20 c.c., liq. ferri perchloridi 2 drops) into a yellow or greenish-yellow. For perfect accuracy, when vomit and not the test-residuum is examined, it is necessary to extract the filtrate with ether, evaporate, and use a solution of the residue in water.

The total acidity may be thus determined. Ten c.c. of the filtrate with three drops of a saturated alcoholic solution of phenolphthalein are diluted with distilled water to 100 c.c. This is divided into two equal parts, and each part is placed in a beaker standing on white paper. To one part decinormal solution of sodium hydrate (4 grms. of sodium hydrate dissolved in a litre of distilled water) is added drop by drop until a red colour appears. The unused part serves for comparison. The total acidity may now be expressed by a figure (commonly 40–60) which represents the number of c.c. of the alkaline solution which are required to neutralize 100 c.c. of the filtrate. Thus if 5.5 c.c. are required to neutralize 10 c.c. of the filtrate, the total acidity is expressed by the figure 55 on Ewald's scale.

For examination for organic acids (other than lactic acid), for peptones, starch, sugar, erythrodextrin, and for the methods by which the activity of pepsin and rennin, and the motor and absorptive powers of the stomach are estimated, reference should be made to a systematic work on the subject.

GASTRIC ULCER

The illness entailed by an ulcer of the stomach is usually a long one, and patients come before us at different stages in this long career. At all stages the dietetic treatment is of the greatest importance. There is good reason to believe that the number of cases of "chronic" ulcer and "recurring" ulcer might be reduced if a more rigid diet were maintained for a much greater length of time than is now customary. But it must be allowed that such a plan is often found to be difficult or impossible, considering that the bulk of the cases of gastric ulcer are drawn from the class of working girls, who have little choice as regards food, and no opportunity for rest.

For the purpose of dietetic treatment cases of gastric ulcer may be arbitrarily divided into several classes: (*A*) Very commonly the patient comes under treatment within a few hours after an attack of hæmatemesis; (*B*) sometimes days or weeks have elapsed since the hæmatemesis; (*C*) there is often a long antecedent stage during which (in the absence of hæmatemesis) an ulcer is suspected but cannot be recognized with certainty; (*D*) often hæmatemesis has occurred on several occasions in the past, or with one previous hæmorrhage there has been continual pain after food, so that the story may run back for years. Though gastro-enterostomy should always be performed in such cases, dietetic treatment still remains a necessity. One cannot help thinking that in these cases the chronicity or recurrence of the disease is often due to defective treatment at their outset; (*E*) the patient may come before us suffering entirely from one or more sequelæ consequent on the healing of an ulcer, such as pyloric stenosis, perigastric adhesion and hour-glass contraction; (*F*) in a small proportion of cases (about 10 per cent of hospital admissions) perforation occurs without previous symptoms of ulcer, and after recovery from operation (with or without gastro-enterostomy) dietetic treatment is as important as in any of the other classes.

The dietetic treatment in all these classes is directed to the affording of rest to the stomach. Movements of the stomach-wall delay cicatrization of the ulcer, and in the few days following hæmatemesis movements may disturb the thrombus upon which safety depends. But rest to the secretory as well as to the motor function of the stomach is needed, and the food given (especially in the later stages of treatment) must be such as will reduce the secretory requirements to as low a level as possible, and this choice of food will at the same time tend to keep down the hyperacidity (q.v.) which is such an important accompaniment of gastric ulcer. These principles are matter of general agreement, but in points of detail it will be seen that there is room for difference of opinion.

(*A*) Immediately after Hæmatemesis

I do not doubt that for the first few days after hæmatemesis no food or fluid should be given by the mouth and that strict rectal feeding should be adopted. I feel sure that even the giving of small pieces of ice is pernicious. During these few days we are not concerned with the healing of the ulcer. Our object is to avoid mechanical disturbance of the thrombus during the few days necessary for the beginning of its organization.

Opinions differ, however, as to the duration that should be prescribed for this strict rectal feeding. The principle of rest to the stomach is good, and there are those who carry it out to the extreme by employing it for two or three weeks. On the other hand it must be recognized that rectal feeding is always a state of semi-starvation, which is not calculated to promote the healing of an ulcer. Moreover, during prolonged rectal feeding it is probable that further disadvantages occur, which militate against cicatrization. The oral and gastric secretions are absent or small. The mouth is apt to become dry, and the tongue foul, so much so that parotitis occasionally sets in. It is probable that owing to the lack of acidity there is an abnormal growth of bacteria in the stomach, as there certainly is on the tongue. Presumably also, as in the case of all disused organs, there is some degree of bloodlessness of the stomach during deprivation of food. So that even if we possessed a method of maintaining the general nutrition, while keeping the stomach empty and at rest, I doubt if it would be wise to employ such a method for long. It is a matter of opinion and admits of no proof, but I believe not only that the gastric ulcer is formed suddenly by necrosis to a varying depth of the stomach-wall and the immediate digestion of the necrosed area, but also that there is from the first a strong natural tendency to rapid healing of the ulcer, if during this early stage the local and general conditions are favourable.

Impressed by the necessity of procuring stomach rest at all costs, some physicians maintain strict rectal feeding for long periods, two or three weeks in some cases. But there is an opposite extreme, and Lenhartz, influenced by the malnutrition and other evils which attend rectal feeding has discarded it. Even on the day of hæmorrhage he allows 7–10 oz. of iced milk in spoonfuls, and from 2–4 beaten eggs in the 24 hours. For my part I think that strict rectal feeding for a certain time is necessary after hæmorrhage and that the advantage gained, if it is not too prolonged, outweighs any possible malnutrition. As regards the duration of this stage of treatment, each case must be considered on its merits, and no definite rule can be laid down. In all cases I think that at least three or four days should elapse after hæmorrhage before any food or fluid can be safely given by the mouth. As a matter of fact after an interval of four clear days hæmorrhage seldom recurs. During the actual occurrence of hæmatemesis, the rule of course must be absolute. In cases of recurring hæmorrhage, this practice of allowing three or four days to elapse without food or fluid by the mouth after the last appearance of blood, necessitates in some cases a much longer period of rectal feeding than is desirable. But it is a choice of evils and for the moment stoppage of bleeding and organization of clot are more important objects than healing of the ulcer.

The technique of rectal feeding is discussed elsewhere. I prefer 10 oz. or 15 oz. injections of normal saline solution containing 1 oz. of dextrose at 100° F. every 4 or 6 hours, as being more cleanly and quite as useful as nutrient enemata. Moreover though it is not proved, there is evidence to show that the use of nutrient enemata may excite the secretion of gastric juice, which tends to prevent that complete functional rest of the stomach which it is our object to attain.

After the lapse of these few days of stomach-rest, small quantities of milk may be given by the mouth, while rectal feeding is continued. But even now mouth feeding must be tentative and on a small scale. Each case requires careful supervision, and the stages of treatment described can only be taken as affording a rough guide. Of a mixture of 21 oz. of milk and 9 oz. of lime-water or barley-water, 2 oz. may be given every 2 hours for 9 doses in the first 24 hours. On the second or third day if no pain occurs, while rectal feeding is continued, perhaps on a reduced scale, 30 oz. of this mixture may be given, in 5 oz. doses every 3 hours for 6 doses. It should be given at the body-temperature, and should be taken slowly, preferably with a spoon. From this time onwards the dose of food and the time of taking it should be methodically recorded. Thus within 6 or 7 days of the last sign of bleeding, the patient should be taking food to the value of about 420 calories. The increase of milk must be made with caution. As we have no direct means of ascertaining to what degree healing of the ulcer is taking place, it is necessary to take pain and vomiting as our guide. Recurrence of pain or vomiting requires a reduction of the dose, or a slower rate of increase. It is wise always to proceed on the supposition that the ulcer is large and deep. As a rule there is no necessity to peptonize the milk.

After three or four days of this diet rectal feeding can generally be discontinued, as the milk is increased. The calorie-value of the diet may be raised to 560 by giving 6 oz. of milk mixture (28 oz. of milk with 8 oz. of diluent) for 6 doses every three hours. And in a day or two the value of 800 calories may be reached by giving 8 oz. of milk mixture (40 oz. of milk with 8 of diluent) for 6 doses every 3 hours. This however is still a starvation diet. To supply the nutriment necessary for restoration of health by continual increase of milk alone, requires milk in such quantity that its bulk and weight have disadvantages. Some casein preparation may well be added. Any one of the numerous preparations such as sanatogen, protene, nutrose, etc., may be used. But plasmon is especially useful, and three teaspoonfuls will yield 70 or 80 calories. The day's supply of three teaspoonfuls should be converted into a thick paste, before it is added to the milk, by stirring it with 5 oz. of tepid water. Junket may be used instead of plasmon to supply the extra protein. As a change one or two doses of milk may be made into jelly (1 oz. of isinglass to 1 pint of milk with 5 oz. of cream added and a flavouring of lemon).

This first stage of milk and plasmon-milk diet should generally be completed about 14 days after mouth feeding was commenced, but its duration must vary with the severity and special character of each case, and it is sometimes necessary to prolong it.

As regards the second stage of treatment there is some difference of opinion as to the relative merits of carbo-hydrates and protein. The Continental practice consists mainly in the addition to the milk diet of eggs and bouillon. As will be shown later, Lenhartz gives eggs freely with the excellent purpose of neutralizing excess of acid in the gastric juice and apparently with excellent results. But there arises here the same question which is discussed in connexion with "hyperacidity," viz., the relative advantages of a carbo-hydrate and a protein diet, the former tending to minimize the secretion of acid, the latter tending to increase the secretion, but at the same time to neutralize it. I believe that the use of eggs and meat-extracts should be still further postponed, and that for this second stage, which should certainly be of 14 days duration at least, carbo-hydrates alone should be added to the diet. There is no proof that more protein will hasten cicatrization and in my experience a recurrence of pain or discomfort is often noted on the addition of eggs at this stage.

A calorie value of at least 1,200 should be reached, and this can be attained with some variety of fare. At least two pints of milk should still be given diluted as before, but milk may also be used in combination with carbo-hydrate food. Two teaspoonfuls of plasmon may be retained and there is no necessity to add further protein. Carbo-hydrate food to the weight of 2 oz. may be used. This can be given as arrowroot, bread and milk, rusks and milk, cornflour blancmange, Benger's food, cornflour pudding or even thin white bread and butter without crust. The diet of this stage may be arranged on the following plan :—

6 a.m.	Milk and plasmon, 8 oz.
8 a.m.	Milk-mixture, 6 oz.
	Arrowroot, 2½ oz.
	Thin bread and butter, 1 oz.
noon	Milk and plasmon, 8 oz.
	Thin bread and butter, 1 oz.
4 p.m.	Cornflour blancmange, 2½ oz.
	Milk-mixture, 6 oz.
	Thin bread and butter, 1 oz.
8 p.m.	Milk-mixture, 6 oz.
	Arrowroot, 2½ oz.
10 p.m.	Milk-mixture, 8 oz.

The extra protein required may be given by junket instead of by plasmon.

If at the end of four weeks from the beginning of mouth feeding this amount of food can be taken without any discomfort, it is very unlikely that further trouble will occur in the next stage. Presumably cicatrization of the ulcer is proceeding satisfactorily, but the actual condition of the ulcer is unknown and all extensions of the diet must be made as cautiously as before. Two or three eggs may now be added, cooked or in custard or beaten up in milk. Bread or rusks and butter are permitted, and other varieties of starchy food such as sago, tapioca and potato-purée. Milk-soup flavoured with onion, celery or turnip can be given, and any clear soup, chicken-broth, mutton-broth or beef-tea, if their low nutritive value is remembered.

A sample diet supplying 1,800 calories may be thus constructed :—

7 a.m.	Two rusks.
	Milk, 8 oz. flavoured with coffee.
9 a.m.	Cocoa made with milk, 8 oz.
	1 egg lightly boiled or poached.
	Thin bread and butter, 1 oz.
1 p.m.	Milk-soup, 8 oz.
	Milk pudding or custard with one egg, 2½ oz.
	Thin bread and butter, 1 oz.
	Milk, 8 oz.
4 p.m.	Two rusks and milk, 8 oz.

6 p.m.	Chicken-broth, 6 oz.
	Milk pudding or custard with 1 egg, $2\frac{1}{2}$ oz. (or 1 egg lightly boiled or poached and junket made from 10 oz. of milk).
	Thin bread and butter, 1 oz.
	Milk, 8 oz.
8 p.m.	Two rusks and milk, 8 oz.

Such a diet consisting of milk, eggs, carbo-hydrate and fat should be maintained for at least 14 days, and in many cases this third stage may be further prolonged with advantage. I think that extra days spent on this diet mean an increased chance of sound and permanent healing.

Fish and chicken should not be allowed until at least six weeks have elapsed since mouth feeding was commenced. The diet in this final stage should have a value of about 2,500 calories, and considerable variety becomes possible and there is much scope for cookery. The meals should be small, all hard particles should be avoided and cellulose should be kept at a low level. On resuming such a liberal diet it is especially important to inculcate the habit of thorough mastication and slow eating. If, as is usual at this point, the patient is up for part of the day, at least half an hour of complete rest lying down should be taken after every meal. When some fish, preferably a piece of boiled sole has been taken on two or three occasions at the midday meal without discomfort, the patient can be advanced to some such diet as is detailed below. Milk, carbo-hydrates and eggs must still form a large part of the diet. Fish (sole, plaice, whiting or haddock), sweetbread, chicken, pigeon and pheasant may be added with potato or cauliflower. This diet admits of considerable variation and need not be monotonous. It should not be materially altered for at least three months, and the longer the patient can be made to abstain from meat, tea and alcohol the better is the result. For the working classes such a diet can be obtained while the patient remains in hospital. On her departure from hospital, which is generally premature, the patient should be provided with some such diet-list, and though fish and chicken are often beyond her reach it is possible for her to resume work on a diet of milk, carbo-hydrates, butter and eggs.

In this late stage of treatment the food must be suited to the patient as carefully as before. Occasionally even now there is complaint of pain or discomfort after certain articles of food. This will necessitate some alteration in details of the diet, but it need not lead to the idea that the ulcer is still unhealed. For it is clear that after the healing of an ulcer, especially in neurasthenic subjects, a veritable hyperæsthesia of the gastric mucosa may persist, so that certain articles produce pain immediately they enter the stomach.

Final Diet for Gastric Ulcer

8 a.m.	Milk flavoured with coffee, 8 oz. (or cocoa made with milk).
	One or two eggs lightly-boiled, poached or scrambled.
	Thin bread and butter, 2 oz. (or rusks and butter).
10.30 a.m. . . .	Milk, 8 oz.
	A rusk.
1 p.m.	Sole boiled, fried or filleted or fishcake, 3 or 4 oz. (or quenelles of haddock or sweet-bread with white sauce).
	Cauliflower, 2 oz. (or potato-purée or both).
	Milk pudding made with egg, 2 or 3 oz. (or custard or savoury omelette).
	Thin bread and butter, 2 oz.
	Milk, 8 oz.
4.30 p.m. . . .	As at 10.30 a.m.
7 p.m.	Clear soup, or milk-soup, chicken-broth, mutton-broth, 6 oz.
	Chicken panada or soufflée, 3 oz. (or veal quenelles).
	Potato-purée, 2 oz.
	Milk pudding, 2 or 3 oz. (or custard or junket and cream).
	Thin bread and butter, 2 oz.
	Milk, 8 oz.
10 p.m.	As at 4.30 p.m. (or Benger's food, 6 oz.).

The plan of graduated feeding which has been described is of considerable antiquity. In 1901 a protest against its continuance was made by Lenhartz. In his view healing of a gastric ulcer is not promoted by stomach-rest and proceeds but slowly under a strict milk diet. He considers that the high acidity of the gastric juice which is so commonly associated with gastric ulcer, is not lessened by milk feeding, and that such feeding tends to maintain the anæmia and may even produce such serious inanition as to delay or prevent the cicatrizing process.

Further he believes that nutrient enemata excite an intestinal peristalsis, which spreads to the stomach and may induce renewed bleeding. Finally he is alive to the defect of continual increase of milk (up to 1,600 or 1,800 calories) which is generally admitted, viz., that the weight and bulk of 3 or 4 or more pints of milk constitute serious drawbacks to their use.

He recommends therefore immediate feeding and a rapid increase of food, so that the patient receives the value of 3,000 calories 14 days after hæmorrhage or after the commencement of treatment. On the first day, even on the day of hæmorrhage, the patient receives 8–10 oz. of iced milk given in spoonfuls and two beaten eggs. The eggs are beaten up entire (with a little sugar) and before use they are surrounded with ice and are thus given cold. The following table shows this rapid method of treatment :—

Days after last Hæmatemesis.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Eggs[1] .	2	3	4	5	6	7	8	8	8	8	8	8	8	8
Sugar with eggs, grms.	—	—	20	20	30	30	40	40	50	50	50	50	50	50
Milk, c.c.	200	300	400	500	600	700	800	900	1,000	1,000	1,000	1,000	1,000	1,000
Raw chopped meat, grms. .	—	—	—	—	—	35	70	70	70	70	70	70	70	70
Milk rice .	—	—	—	—	—	—	100	100	200	200	300	300	300	300
Zwieback	—	—	—	—	—	—	—	20 = one piece	two pieces	2	3	3	4	5
Raw ham	—	—	—	—	—	—	—	—	—	50	50	50	50	50
Butter .	—	—	—	—	—	—	—	—	—	20	40	40	40	40
Calories .	280	420	637	777	956	1,135	1,588	1,721	2,138	2,478	2,941	2,941	3,007	3,073

[1] From the first to the seventh day inclusively the eggs are beaten ; from the seventh to the fourteenth day inclusively half are beaten and half are cooked.

(*B*) Days or Weeks after Hæmatemesis

In these cases again the question of rectal feeding comes up, and the advantages and disadvantages of such a course need not be repeated.

Here there is presumably no question of disturbance of an organizing thrombus in an open vessel. But we have no means of knowing the exact state of the ulcer. Often after hæmatemesis the patient has struggled on with something like her ordinary diet, and the early tendency of the clean-edged ulcer to heal quickly has been impaired or lost. I think it is wise therefore to start with two or three days of saline injections per rectum and an empty stomach. Milk feeding may then be proceeded with on the plan already described. But if, in the time that has elapsed since the hæmatemesis occurred, the patient has been efficiently treated, it may be possible to shorten the early tentative period of milk feeding and to reach the second stage of milk-carbo-hydrate diet in a few days.

(*C*) Suspected Ulcer

In cases which present the history and signs of ulcer without hæmatemesis, we can be guided in the question of rectal feeding by the urgency of the vomiting. A short period of an empty stomach may be necessary, but the patient can often be placed at once on a milk diet to the value of 560 calories, and can proceed with the treatment from that point.

(*D*) Chronic Ulcer

In some cases months or years have been spent in illness. With intervals of improvement, the patient has seldom been able to take solid food without pain, vomiting has become a habit and its recurrence is welcomed, malnutrition and secondary anæmia are obvious, and there has commonly been hæmatemesis on one or more occasions. The treatment of such patients in the early and curable stage of the ulcer is generally found on inquiry to have been half-hearted and imperfect.

If for any reason surgery cannot be employed, the best chance of cure is afforded by a milk-carbo-hydrate diet, which must be liberal from the first in view of the malnutrition. In many cases improvement will follow a prolonged course of such a diet, but there is no ground for being sanguine as to an ultimate cure.

I believe that gastro-enterostomy should be urged on all such patients and that dietetic treatment should follow, and that only by the conjunction of surgical and medical treatment is there any real prospect of recovery. The healing of even a chronic ulcer may be comparatively rapid under these conditions, as is shown by the following case. "A man aged 42 in St. Thomas' Hospital had suffered from the symptoms of gastric ulcer for six years with hardly any intermission. Hæmatemesis had occurred on several occasions, the last occasion being the day before operation. Posterior gastro-enterostomy was performed and an ulcer was found on the anterior wall of the stomach which was adherent to the liver. No pain or vomiting occurred thereafter, and the patient was soon able to take a full diet in perfect comfort. He died two months after the operation from rapid tuberculosis of the lungs, and at the autopsy the ulcer seen at the time of operation was found to be completely healed."

After the performance of gastro-enterostomy the diet must be arranged with the knowledge that a thick-walled ulcer is present. But in these cases there is commonly such malnutrition that feeding should be from the first as liberal as is compatible with safety. On the first day after operation milk diluted (2 to 1) with lime-water or barley-water may be given in 1 oz. doses every hour. On the second day milk-mixture (4 to 1) may be given in 5 oz. doses every 2 hours, and on the third day some carbo-hydrate may be added in the form of Benger's food or arrowroot. A full milk-carbo-hydrate diet may be reached in a week, and in many cases fish and chicken can be taken at the end of the second week. But for many months thereafter the patient should adhere to the final diet-list already detailed.

The rapid gain of weight that commonly follows the operation is sufficient proof of its value. The relief that is afforded to the stomach by the shortening of the period of gastric digestion far outweighs any disadvantage which may accrue from deficient absorption. As a matter of fact metabolism is practically unaffected. In Paterson's observations "in none did the unabsorbed nitrogen amount to more than 2 per cent above the amount usually passed in the fæces by a healthy individual, while the amount of fat passed unabsorbed did not on any occasion exceed 7·7 per cent of the fat taken in the food, that is, just over 2 per cent above the amount usually passed in the fæces by a healthy man."

In all cases where one genuine and sufficient course of dietetic treatment has failed to effect a complete cure, I think the operation should be strongly recommended to the patient.

(*E*) Sequelæ of Gastric Ulcer

Pyloric stenosis is easily recognized and must be dealt with by a surgeon. The subsequent line of dietetic treatment will depend on the presence or absence of an unhealed ulcer. In many cases of cicatricial contraction of the pylorus a chronic ulcer is situated in the neighbourhood.

Perigastric adhesions and hour-glass contraction of the stomach are matters of greater difficulty. On a slender milk-carbo-hydrate diet patients suffering from these conditions may continue to live without much discomfort, but there can be no return to a sufficient full diet without surgical relief. A suspicion of the existence of these sequelæ requires exploration and their treatment by gastrolysis, gastro-enterostomy or otherwise. The diagnosis of adhesions is extremely difficult and there are no pathognomonic signs, by which their presence can be recognized. The pain that results from them does not differ materially from the pain which is sometimes experienced by neurasthenic women even after the cure of an ulcer. Such cases require careful observation, and, inasmuch as in the hyperæsthetic state of neurasthenia operation can do no good and often does harm, exploration should not be hastily recommended.

DUODENAL ULCER

This general plan of the treatment of a gastric ulcer can be adopted when the ulcer is on the duodenal side of the pylorus. The same rules hold good, but there is one important difference. The duodenum is disturbed only at intervals by the passage of food-stuffs from the stomach, and it has none of the churning movements that tend to prevent the healing of an ulcer in the stomach. Consequently the rate of progress in the steady increase of food may be rather more rapid. In the final diets special care must be taken to keep down any tendency to hyperacidity.

HYPERACIDITY

(Syn. Hyperchlorhydria, Acid dyspepsia)

This condition must be considered as a **secretory neurosis,** either inborn or provoked by errors of diet and life. In cases of long duration it is possible that secondary glandular proliferation may occur, and it is certain that a secondary slight gastric dilatation sometimes ensues. It is the commonest form of indigestion. The characteristic symptom is a burning or gnawing pain in the epigastrium, which begins one or two hours after a meal, or sometimes even later, so that it is described by the patient as "preceding" a meal. It seldom occurs at night. The patient has generally discovered that the pain is relieved by food, by bicarbonate of soda, or by vomiting. Natural vomiting is uncommon, but some patients have been taught by experience to provoke it with the finger. Flatulence (the gas being partly derived from the carbonates of saliva and bile), substernal heartburn, and acid eructations are common. Occasionally severe attacks of gastric (probably pyloric) spasm occur, generally associated with paroxysmal pyrosis.

These symptoms are due to a rapid and excessive secretion of gastric juice. Free hydrochloric acid is found earlier after a test-breakfast (even within ten minutes) than under healthy conditions ; the total acidity at the height of digestion, expressed in terms of hydrochloric acid, commonly rises to 0·3 per cent, occasionally even to 0·6 per cent, or it lies between 70 and 100 on Ewald's scale. It is probable, also, that in some severe cases secretion continues even after digestion is completed (cp. hypersecretion). Before dietetic treatment is undertaken, it must be made clear that the symptoms are due to hydrochloric acid and not to organic acids. Though organic acids set free by bacterial or toruloid action can notably increase the total acidity of the contents of the stomach, this occurs on a large scale only in cases of pyloric obstruction and gastric dilatation, a condition which as a rule is sufficiently obvious. A total acidity above normal (above 60 on Ewald's scale) after a test-dinner establishes the diagnosis.

If this perversion of secretion is considered in relation to digestion, it will be clear that the normal allowance of time during which starch digestion can continue in the stomach is curtailed by this premature rise of acidity. It ceases when hydrochloric acid amounts to 0·12 per cent. Protein-digestion however is usually well performed, but Boas has recorded cases, in which pepsin was absent and protein-digestion delayed. Theoretically it might be supposed that in consequence of the excessive acidity of the chyme as it enters the duodenum the pancreatic digestion of fat would be delayed, but in practice I do not think that there is evidence of this, though a dislike for fat is occasionally noted. As a rule the stomach is emptied at any rate within normal limits of time, but in severe cases there is delay, which is probably due to pyloric spasm, and occasionally some degree of dilatation results. Perhaps the delay of digestion, which occurs when much starch is taken, may also tend to produce this result. After long continuance of hyperacidity some degree of chronic gastritis may supervene, manifested by a greater tendency to vomit and the appearance of mucus in the vomit.

These points, which must be realized in prescribing a suitable diet, present the malady only in its simplest form. Many cases however are complex, and the associated conditions and antecedents must be reckoned up and weighed. Associated with hyperacidity there is often a real gastric hyperæsthesia, either a primary sensory neurosis or a secondary result of continued hyperacidity, and the mere contact of food with the gastric mucosa will then excite pain or discomfort. A loose right kidney and gastroptosis in women are not uncommon associations and add greatly to the difficulty of treatment. Although hyperacidity is commonly associated with gastric ulcer, hyperacidity does not in that association present the characteristic symptoms described above, and gastric ulcer is rarely present and need seldom be suspected, when those typical symptoms are clearly marked. In pure hyperacidity it may be noted that easily digested foods are as likely to produce pain as indigestible articles, and that a large meal may be better borne than a small one. From duodenal ulcer there is greater difficulty of distinction, and the symptoms of such an ulcer and those of hyperacidity may have a close resemblance. The possibility of the co-existence of the two conditions must always be borne in mind, and the occurrence of hæmatemesis or melæna in a patient who has long suffered from hyperacidity should cause no surprise. The occurrence of pain in the back and rigidity of the right rectus should be noted in this connexion.

Further if treatment is to be precise, some idea must be gained as to the **cause of the hyperacidity.** It is clear that it arises in some cases from gross causes, such as imperfect mastication, food bolting, hurried meals immediately followed by active movement, excess of protein in the diet, abuse of alcohol, of gastric stimulants and I believe of tobacco. Habitual overfeeding certainly plays a part in the causation in some cases. Some go so far as to regard hyperacidity as being mainly due to long continued excess of protein food. Hemmeter for example suggests that it is an "adaptive process," meaning that the power of the glandular structures to secrete acid has been increased in response to the excessive stimulus of excess of meat in the diet. Certainly it is not a common condition in hospital classes, of whose diet bread and butter are the chief constituents. Such cases as seem to arise from one or more of these avoidable causes afford great satisfaction in treatment. But a history of such a faulty life is by no means so commonly obtained as in cases of dilatation and chronic gastritis. Hyperacidity often occurs without any obvious avoidable cause.

The general health is usually good. But in many cases an obvious nervous defect underlies the condition. Though it is more common in men than in women, its subjects are usually high-strung and excitable, apt to hurry when no haste is needed. They may belong to the leisured class and voluntarily adopt a strenuous life, but commonly they are tied to an occupation which entails quick meals, train-catching, excitement and worry. This is often found to be a serious obstacle to successful treatment. It is aggravated by shock, emotion or work under pressure, and in some patients it occurs in attacks only under such influences, so that in quiet times any kind of food can be taken with impunity. As in all gastric and intestinal neuroses, idiosyncrasies as regards certain articles of diet may come to light when treatment is begun, and these will add to the difficulty.

Constipation also is generally a source of trouble. If the condition is of long duration and does not yield to treatment, it usually leads to pessimism and depression. Even after a complete cure I believe the patient should be warned that his days for large promiscuous meals are over, and he should be furnished with a rigid diet list and an outline of a healthy life.

The **dietetic treatment** of hyperacidity is difficult, but it is always promising, because, unlike the sufferer from some other abdominal neuroses, the patient has a genuine desire to be quit of his trouble.

In severe cases of long standing, when the patient is seldom free from pain and has begun to lose weight, it is wise to give him two weeks of complete rest in bed. If on CO_2 distension of the stomach, any real dilatation is found to be present, lavage may be performed on the first three days of this time, but it should not be performed unnecessarily. During the first week there should be semi-starvation, milk to the value of 560 and later of 800 calories being given as in the case of gastric ulcer (q.v.) with a large dose of Carlsbad salt in hot water every morning on an empty stomach. During the second week of complete rest the diet may be gradually extended. If as is usual the gastric mucosa has now lost its extreme sensitiveness, one or two eggs, lightly-boiled, poached or even buttered, may be tried, and later the addition of 4 oz. of milk pudding or rusks in milk may be made, so that at the end of the second week the patient is receiving sufficient food to supply nearly 1,500 calories. He will probably be found to have lost some more weight. During the third week he may be allowed out of bed, to drive and to take short walks and to prepare for a resumption of ordinary life. During this third week the degree of secretion-response to the stimulus of food may be further tested by the addition of fish (sole, plaice, whiting) or chicken to the diet. Milk should still form a large part of the diet, viz., 40 oz. with 8 oz. of diluent, and the meals may be arranged on the following plan :—

8.30 a.m. . . .	Milk diluted, 8 oz.
	One or two eggs cooked in any way.
	Toast or rusks, 1 oz.
	Butter, ½ oz.
11 a.m.	Milk as before.

1 p.m.	Milk as before. Fish (sole, plaice or whiting) or chicken, 4 oz. Custard or jelly or blancmange with cream, or savoury omelette, 4 oz. Toast or rusk and butter as before.
4.30 p.m. . . .	Milk as before.
7 p.m.	Milk as before. One or two eggs cooked in any way. Toast or rusk and butter as before.
10 p.m.	Milk as before. Rusk.

The duration of this stage and the subsequent course must depend on the result obtained. As a rule he is now able to resume an ordinary life and he will soon be able to embark on the correct diet which, with few alterations, should serve him for the rest of his life.

In one group of cases, as already mentioned, the immediate cause of the hyperacidity becomes plain, when the patient's manner of life and feeding is grasped. There may be much to correct. In some such cases it is sufficient to set matters right as regards the teeth, to explain the importance of prolonged mastication, slow eating and early hours, to enjoin at least thirty minutes of complete rest lying down after each meal, to cut off or diminish alcohol and tobacco, and to increase the amount of exercise in the open air. Furnished with a simple diet he can then see the end of his trouble. But though the cause may be plain, its correction may be an impossible counsel of perfection in the case of a man, whose life and habits are necessarily dominated by his work. In these cases over and above the establishment of a correct diet, we must fall back on the use of antacid medicinal remedies which palliate but do not cure. However in all cases an attempt must be made on general principles to remove any causative factor and to minimize the nervous predisposition.

When we consider the details of a diet which shall be suitable (1) for the partly cured patient who has been through the short rest cure described; (2) for the patient who is half cured as soon as the exciting cause is discovered and, (3) for the patient whose chance of improvement is small so long as his livelihood depends on the continuance of an unhealthy and hurried existence we find general agreement on many points. All condiments and spices, mustard, pepper, vinegar, horseradish, ginger, curry, etc., must be forbidden, as well as all vegetables containing much cellulose and salads. No article of food should contain hard material such as pips and seeds. Coffee should be excluded, cocoa or tea freshly made with half milk being allowed. At first no alcohol in any form should be taken, but as time goes on without the recurrence of symptoms its use may be safely resumed with the limitations mentioned later. All starch (if it is used) should be dextrinized by dry heat as in thin toast and rusks, or thoroughly gelatinized by moist heat as in milk puddings. Pastry must be avoided. Fresh uncooked butter and cream may be taken freely and perhaps tend somewhat to lessen the secretion of gastric juice. Sugar may be freely used, preferably dextrose or honey. Jellies are useful, gelatine fixing a good deal of hydrochloric acid in its digestion: they may be flavoured with lemon, orange or fruit-juice if necessary, but fruit itself should be avoided. Milk, eggs, and grated cheese are always correct articles of diet. Junket flavoured with cocoa can be taken. Soup may well be avoided, in view of its stimulant effect and its small nutritive value. Fluid may be given freely at meals, if there is no dilatation, and either milk and soda-water or any mineral water such as Perrier and Apollinaris should form the staple drink. The temperature of food should be considered and extremes avoided by preserving a minimum of 55° F. and a maximum of 130° F.; a temperature of 100° F. may serve to minimize the stimulus to the secretion of acid.

On certain other points however there are divergent views. In the first place inasmuch as the acid of the gastric juice is solely derived from the chlorides of the blood, it has been suggested that in hyperacidity this supply should be diminished by **forbidding the use of common salt** both as a condiment and in the cooking of food, so that the patient becomes dependent for his chloride supply on the salts naturally present in his food. It has been shown experimentally by Cahn and by Hemmeter that the acidity of the gastric juice is materially reduced in dogs, if they are fed on meat, from which the salts have been largely extracted by boiling with distilled water. Moreover Cahn by further means so reduced the chloride-content of the blood that the stomach secreted a neutral inactive fluid. This fluid however if acidified at once became active and digested fibrin, so that we may conclude that the secretion of pepsin is independent of that of the acid. Without actual observation of the point no patient can state how much salt he is in the habit of taking. I have seen a few patients suffering from hyperacidity who confessed that they took exceptional quantities of salt, but I think that the majority of patients are moderate in its use. It may be argued from the universality of the practice that salt eating is in some way beneficial or even necessary. But some people take no salt apart from that naturally contained in their food or introduced by the cook, and suffer no harm. On the whole I believe that it is wise to eliminate salt from the diet in this condition, though I have seen no immediate beneficial results in patients who have so excluded it.

In the second place there are different views on a more important point, viz. the **relative advantages of an amylaceous and a protein diet.** The dilemma may be stated thus. (1) It is certain that in hyperacidity digestion of starch in the stomach is quickly brought to an end by the early rise of acidity and the appearance of free acid. In fact in some cases the discomfort is largely due to the presence of large quantities of starch in the stomach which cannot be dealt with. On the other hand protein food is not only quickly digested, but it fixes and combines with acid in the process, and protein food will often relieve the discomfort, which is the chief feature of the malady. So that it would appear obvious at first sight that the diet should be mainly protein, carbo-hydrate food being administered only as sugar or, if as starch, only in very small quantity. (2) On the other hand it is equally certain that protein is a far greater stimulant to the acid secretion than carbo-hydrate food. Carnivora have more acid in the gastric juice than herbivora. Hemmeter has shown that the acidity of the secretion in carnivora can be diminished by feeding on a carbo-hydrate diet for a long time. It has been said also that hyperacidity is rare among Eastern races who live mainly on carbo-hydrates. So that it may be argued that by insisting on a protein diet, we relieve the symptoms, but perpetuate the malady.

It is clear that the amylaceous diet has a curative aim, while the protein diet is directed to relief of a symptom. There are advocates for both diets in their entirety. It is possible to take a middle course. I believe that the protein diet, dealing as it does with symptoms alone, is the most suitable for, and should be confined to the third class of patient mentioned above, generally a clerk, who is so placed in his work that no attempt at a complete cure can be made. But even to him some starch should be allowed—and I do not think he suffers from the addition of $\frac{3}{4}$ oz. of thin toast or rusk at his three chief meals, or from 2 oz. of milk pudding at his evening meal. To him also may be recommended the palliative taking of milk, meat lozenge, bicarbonate of soda or the bismuth lozenge when the pain comes on at his work. Chewing gum with resulting flow of saliva and consequent neutralization of some acid in the stomach is permissible with the same object. But as a curative line of treatment I believe that in the long run a simple mixed diet with preponderance of milk gives the best result, if it is remembered that no meal should be a large one, that several small meals are better than two large ones, and that good mastication, slow eating, rest, exercise and moderation in the use of alcohol and tobacco are essential parts of the treatment.

The following is an outline of such a diet :—

Diet for Hyperacidity

Half an hour before breakfast hot water 8 oz., with a small dose of Carlsbad salt.

8.30 a.m. . . .	Cocoa made with milk, 10 oz. (or freshly made tea with half milk). Graham or wholemeal bread toasted, 2 oz. Butter, $\frac{2}{3}$ oz. Honey, $\frac{1}{2}$ oz. One or two eggs cooked in any way.
11 a.m.	Milk diluted (6 to 1) with soda-water, 6 oz.
1 p.m.	Meat (preferably veal, mutton or ham), 2 oz. (or fish, chicken, game, sweetbread or savoury omelette). Milk pudding, 2 oz. (or custard). Toast, 1 oz. Butter, $\frac{1}{3}$ oz. Cheese, $\frac{1}{2}$ oz. Milk diluted, 6 oz. (or water plain or aerated).

5 p.m.	Milk diluted, 6 oz. Toast, 1 oz. (or rusk).
7.30 p.m. . . .	Milk-soup flavoured with celery, turnip or onion, 6 oz. Fish or meat as at lunch. Potato-purée, 1 oz. (or lentils). Milk pudding, 2 oz. (or blancmange, jelly, custard). Toast, butter, cheese as at lunch (or cheese-straws). Milk diluted, 6 oz. (or water plain or aerated).
Bed time . . .	Milk diluted as at 11 a.m.

Finally when it appears that gastric secretion has returned to normal limits the diet may be tentatively altered and extended. Fish or fat bacon may be added to the breakfast. The 11 o'clock milk may be omitted. A variety of vegetables may be taken such as vegetable marrow, Brussels sprouts, lettuce, cauliflower, spinach. Savouries may be added and more elaborate puddings. But simplicity, though it is monotonous, should still be the object. Only when a cure is complete should any alcohol be allowed. Whisky 1½ oz. diluted with at least 7 oz. of soda-water may be taken at lunch and dinner, or claret, hock or Moselle diluted with one third part of soda-water, or light lager beer. Under no circumstances should any alcohol be used in greater strength than in these drinks, and no alcohol is permissible apart from meals.

As an example of a diet based on the use of protein for hyperacidity, that of Wegele may be quoted :—

Morning . . .	Tea with milk, 100 grms. Two soft-boiled eggs.
Forenoon . . .	Raw ham, 100 grms. Cream, 50 grms. Aleuronat meal broth, 200 grms. *Or* oatmeal broth, 250 grammes.
Noon	Beef-steak, 150 grms. Mashed potato, 200 grms. White wine with Saratoga, Vichy *or* Biliner water, 100 grms.
Afternoon . . .	Tea, 100 grms. Cream, 150 grms.
Evening . . .	Cold meat, 50 grms. Two scrambled eggs. Wine, 100 grms.
10 p.m. . . .	Milk, 250 grms. At meal times aleuronat toast, 100 grms.

This diet yields 2,400 calories.

HYPERSECRETION

In considering the subject of hyperacidity it was stated that at the height of digestion the degree of acidity rises to 70 or 100 on Ewald's scale, that the resulting pain and discomfort abate as the stomach empties itself, and that when the stomach is empty the patient is free from all trouble. Hence it is that his symptoms so rarely occur at night.

(a) Continuous Hypersecretion.

In some severe cases, however, the secretion of gastric juice continues after digestion is complete and after the stomach is empty. It occurs apparently in the absence of any stimulus, except such as is afforded by swallowed saliva and mucus.

This form of secretory neurosis, "continuous hypersecretion," is uncommon. It occurs I believe only as a late stage in cases of long-continued hyperacidity which have been imperfectly treated. There is usually a history of many years of gastric illness of the hyperacid type. It requires no separate description, but a few points may be mentioned. In the first place cross-examination of the patient will probably reveal the fact that the pain does not cease when the stomach is empty, but that it runs on to the next meal, so that it is sometimes described by the patient as being at its worst "just before a meal." As in the case of simple hyperacidity, it will have been noticed by the patient that it is relieved to some extent by food or bicarbonate of soda. In the second place the pain is very apt to occur at night, commonly between 12 and 2 o'clock. Thirdly, vomiting and consequent emaciation are more marked than in simple hyperacidity, so much so that a suspicion of carcinoma may be aroused in spite of the long history. Finally some degree of dilatation of the stomach is usually present.

The actual proof, however, of the existence of this continuous hypersecretion can only be reached by washing out the stomach clean over night, and aspirating the stomach in the morning while still fasting. In well marked cases there are obtained from the stomach 4–8 oz. of clear yellowish-green fluid with a specific gravity of about 1,005 and a total acidity between 60 and 80.

As regards the dietetic treatment nothing need be added to the outline given under hyperacidity, and the same question discussed under that heading as regards the relative advantages of an amylaceous and a protein diet comes up again here. But hypersecretion is a more severe condition than hyperacidity and much less tractable. It is more than ever important to start a course of treatment with a period of semi-starvation and the minimizing of gastric stimulation. And as there is here no healing process required, as in the case of gastric ulcer, malnutrition may be disregarded and some loss of weight need cause no anxiety. The patient will generally submit to any restrictions in his desire to recover.

The slight rest cure recommended as the first step in the treatment of hyperacidity should be extended. In certain cases it may be wise even to proceed on the lines laid down for the treatment of gastric ulcer, and to maintain an empty stomach for two or three days with the use of saline injections per rectum, while lavage is performed daily. Milk to the value of 560 calories may then be commenced, and with complete rest in bed the full milk-carbo-hydrate diet described in connexion with gastric ulcer may be reached at the end of a month. As regards the continuance of lavage, one must be guided by the degree of discomfort which persists and especially by its occurrence at night. Thenceforward the treatment must be such as has been described for hyperacidity, attention being paid to the rectifying of all the errors of diet and life which have often contributed to the production of this state. But progress will often be slow and great patience is necessary.

(b) Paroxysmal or Intermittent Hypersecretion

This condition may be mentioned here, though it has not necessarily any connexion with hyperacidity. In its pure form it lies quite apart from that condition, having only this in common, viz., that it is clearly a neurosis independent of any change in the stomach, a manifestation in fact of some disturbance arising elsewhere, which produces its end-effect through the vagus. It may bear a close resemblance to migraine and in some cases the distinction cannot be made. Its resemblance to the gastric crisis of tabes must always be borne in mind. A single attack might be mistaken for the result of some indigestible food or an irritant poison.

Sufferers from this condition are usually young. Attacks are often met with in schoolboys. They are said to be precipitated by emotion. Certainly there is sufficient evidence to warrant the prohibition of tobacco in these patients. The boy's first attempt to smoke will often result in an attack which at any rate has the superficial character of this form of hypersecretion. I have known it to follow the smoking of an unusually strong cigar by an adult. In many cases no dietetic or other error can be discovered, and the occurrence of attacks is capricious and inexplicable.

As the name indicates, the trouble occurs in isolated attacks, the general health and the digestion being often perfect in the intervals. Occasionally there is a history of co-existing hyperacidity. It has been mentioned in connexion with hyperacidity that attacks of severe gastric pain probably due to pyloric spasm with profuse pyrosis sometimes occur. It is probable that these attacks are due to sudden purposeless secretion of gastric juice, but I know of no exact observations as to the contents of the stomach at this time, and opportunity for examination is rare, as vomiting is uncommon. In fact the proof of the nature of an attack can only come from examination of the vomit. But if an attack occurs (as is common) with an empty stomach, especially at night, the presumption is strong that it is an instance of paroxysmal hypersecretion and not a mere digestive disturbance.

The attack usually begins rather suddenly, often in the night, and in typical instances with an empty stomach. Discomfort in the epigastrium soon rises to actual pain, which may be severe. Flatulence and eructations are common, probably due to the interaction of gastric juice and swallowed saliva. Pyrosis is usually the next event, and saliva may stream from the mouth. Vomiting sets in and generally gives some relief for a time. A highly acid fluid is evacuated as in the case of continuous hypersecretion, and acid has been found to the amount of 0·5 per cent. Not only is there epigastric and substernal burning and pain, but in many cases from the character of the pain one must conclude that some part of the stomach-wall, probably the pylorus, is in a state of violent spasm. It may be so severe that the hands grow cold and the face pale, and the mistake may be made of confounding it with a biliary colic. Thirst is often experienced and relief may be gained by drinking alkaline water.

Such an attack usually passes off in a few hours or in a day or two, and good health is resumed, though a weakly patient may be left somewhat prostrate. It may not recur for weeks or months. Sometimes the attack is associated with or followed by severe headache, so that the resemblance to migraine may be close. I know of no case where visual phenomena have occurred.

If hyperacidity coexists, the line of dietetic treatment has already been indicated. But in the pure form of paroxysmal hypersecretion with intervals of good health there is little to be done. The diet, however, must be examined and if necessary simplified. Without any reasons to advance in favour of such a view, I believe it is well to diminish the meat taken by such patients, allowing it only at one meal in the day, preferably at the midday meal. Tobacco and alcohol should be curtailed or forbidden. Opportunity may be taken to ensure good teeth and slow mastication. I think the tendency to this condition wears out with increasing years and wisdom, as is certainly the case with migraine.

MOTOR INSUFFICIENCY AND DILATATION

Under this head are included a large number of conditions which have this point in common, that the stomach is not emptied within the normal limits of time. With this defect there is often associated a secretory insufficiency, but this is not always the case. Motor insufficiency may exist without dilatation, but of all cases of dilatation of the stomach, motor insufficiency actual or relative is the immediate cause.

The group may be divided into three classes :—

(1) **Pure motor insufficiency (gastric myasthenia)** without dilatation, an impairment of the expulsive power, which results in an abnormal tarrying of food in the stomach and a consequent shortening of the rest-periods of that organ. This may be regarded as the initial stage of the next class.

(2) **Dilatation (primary gastrectasis)** without any pyloric obstruction. This results from continued motor insufficiency, delayed digestion and yielding of the stomach-wall, and it must not be confounded with mere temporary distension by gas. A knowledge of the causes of this condition will show that it presents a great field for dietetic treatment. In some cases it clearly arises from over-indulgence in food and drink, from sheer bulk and weight of material taken with short intervals into the stomach, which is often associated with imperfect mastication and rapid swallowing. Both on the motor and on the secretory side enormous demands are thus made on the stomach. The condition of the teeth must always be examined. In many such cases alcoholic drinks are also taken in excess, and in these, as is described elsewhere, a chronic catarrhal gastritis is often present. A moderate degree of dilatation may also occur in connexion with hyperacidity, and its mode of origin is mentioned under that heading. In all cases, therefore, of dilatation resulting from abuse of food and drink, from chronic gastritis, and from hyperacidity, the mere regulation of diet and the teaching of the principles of digestion will often go far to effect a cure.

In another class the myasthenia underlying the dilatation is the expression or result of some general condition. Thus it may follow many of the specific fevers. It occurs in connexion with tuberculosis, malaria, renal disease, and anæmia of all kinds, and, in fact, with any state of profound impairment of health.

Finally, it may occur as a part of neurasthenia, and it is probable that the same quick fatigue, slowness of repair, and absence of reserve are to be noted in the stomach as in the general musculature of such patients. The effect is liable to be greatly aggravated by strong emotion or strain. The treatment of such cases presents great difficulty.

(3) **Dilatation (secondary gastrectasis)**, due to pyloric obstruction. In this class the actual muscular strength of the stomach is often increased, but owing to the narrowing of the exit there is a relative motor insufficiency. Under this head are included such matters as pyloric carcinoma, cicatricial stenosis of pylorus or duodenum, pyloric adhesions, hypertrophic stenosis, and perhaps some instances of pyloric ulcer with spasm.

On meeting with a case of gastric dilatation, the first necessity is to settle the question of its obstructive or non-obstructive character. In the former case treatment by dieting may be necessary, but it can only be palliative and surgical treatment should be adopted as early as possible.

In dealing with a case of non-obstructive dilatation a clear idea must be gained as to its origin, and in many directions, hygienic and therapeutic, a way may be seen by which some improvement can be quickly effected. The principles of dietetic treatment are plain. In many cases of slighter degree they are easily carried out, and are quickly effective. But the matter is one of much greater difficulty, when with the motor insufficiency there is defective secretion of hydrochloric acid. In such cases, which form the most severe type, the trouble is aggravated by fermentation and development of gas. The treatment of a neurasthenic woman of middle age with slow digestion, some dilatation of the stomach, and a moderate degree of gastroptosis is a most difficult task.

The immediate need is the use of food in minimal quantity and of minimal weight, of such a character that it shall be most easily prepared for intestinal digestion and expelled from the stomach. But there need be no fear of passing the patient if necessary through a preliminary period of malnutrition, so as to evoke by a period of stomach-rest such natural tendency to recovery as may be possible. And in severe cases a few days of complete rest of body and stomach with the use of rectal saline injections should be the first step.

Food must be of small bulk and weight. Consequently fluids should be cut down to the minimum compatible with comfort, and a pure milk diet which would otherwise be desirable is out of the question. In severe cases it has been recommended that a really dry diet should be adopted, and that the required fluid should be administered per rectum. But a certain quantity of fluid is absolutely necessary in the stomach to ensure fluidity and ready expulsion of digested food, and 20–30 oz. of fluid by the mouth in twenty-four hours, taken in small quantities at a time, is essential for this purpose. Some patients can take less without discomfort. Alcohol should be entirely forbidden. There is evidence to show that its absorption from the stomach is followed by a secretion of fluid into the stomach. No spices or condiments should be allowed. Tea and coffee should be forbidden, as tending to delay digestion. Food should be hot rather than cold, and a temperature of 110–130° F. is safe and useful. Meals should be small and frequent, and in laying down details of the diet it must be remembered that every article should be of maximum nutritive value, and that digested food leaves the stomach in the shortest time if it is readily converted into semi-fluid or pultaceous form. Green vegetables are therefore excluded. If there is evidence to show that gastric secretion is of full value, protein may be freely given, but meat should be finely divided, and so slightly cooked as to be easily digested. Sweetbread and oysters may be given. Raw meat is often of use. If, on the other hand, secretory insufficiency is present, carbo-hydrates in the form most easily digested must form a larger proportion of the diet, notwithstanding their liability to undergo fermentation. Fat is of use, and fresh butter and cream are usually well taken. All food should be taken slowly and with deliberation, so that mouth digestion should have full time, and even in the slighter cases, an hour of complete rest lying down should be taken after the chief meals. A preliminary period of lavage is always necessary, and the result obtained will give a guide as to the necessity of continuing it. Massage, douching and electrical treatment are most useful.

In the first stage of treatment complete rest in bed is advisable. The diet, which allows of some variety, should consist of milk, plasmon, toast, rusks, butter, cream, eggs, raw meat or beef juice and perhaps pounded fish. Considering the great fall in the value of gastric digestion, one may be tempted to use the trade-preparations of peptones or rather albumoses, as calculated to take the place of protein. There is no doubt that such preparations can replace protein in the diet, and that the nitrogen-equilibrium can be so maintained. But though such articles as somatose, Denayer's albumose-peptone mixture, and Carnrick's peptonoids may be used in some cases with advantage (especially when the stay of food in the stomach is so prolonged that decomposition of protein may occur), it is better as a rule to depend entirely on intestinal digestion and to aim at giving such protein-food as shall be quickly discharged from the stomach. Oysters, sweetbread, raw scraped beef, pounded fish and chicken with a few ounces of milk fulfil this requirement.

A diet to supply about 1,500 calories may be arranged as follows :

8 a.m.	Milk (5 oz.) one or two eggs, two pieces of thin toast with butter.
10.30 a.m. . . .	Milk (5 oz.) with plasmon (for use cp. gastric ulcer), a rusk, two raw meat sandwiches.
1 p.m.	Milk (5 oz.) fish-cake or fish-soufflée, custard, toast and butter.
4.30 p.m. . . .	As at 10.30 a.m.
7.30 p.m. . . .	Milk (5 oz.) one or two eggs, toast and butter.
10 p.m.	Cup of arrowroot with cream.

In a later stage the diet may be extended by the addition of chicken panada or soufflée, raw oysters, sweetbread, minced mutton, milk-jelly, potato-purée, other forms of carbo-hydrates, and cocoa. And if the results are favourable, a claret glass of water, plain or aerated, may be allowed at lunch and dinner. The following is an outline of such a diet, which is sufficient for a patient taking light exercise. Rest after the chief meals should still be adhered to.

Diet in Dilatation of the Stomach.

8 a.m.	Cocoa made with milk, 5 oz. (or milk and plasmon).
	One or two eggs (or fish-cake, 1 oz.).
	Thin toast, 1½ oz.
	Butter, ½ oz.
10.30 a.m. . . .	Milk, 5 oz.
	Rusk.
	Raw meat sandwich, ½ oz. of meat.

1 p.m.	Milk, 5 oz.
	Fish-cake or fish-soufflée, 2 oz. (or oysters).
	Chicken panada, 2 oz.
	Potato-purée, 1 oz.
	Blancmange, 2 oz. (or custard).
	Toast, 1½ oz.
	Butter, ⅓ oz.
4.30 p.m. . . .	As at 10.30 a.m.
7.30 p.m. . . .	Milk-soup, 5 oz. (or milk).
	Sweetbread, 2 oz. (or minced mutton).
	Blancmange and cream, 2 oz. (or grape-nuts).
	Toast, 1½ oz.
	Butter, ⅓ oz.
	Water, 6 oz.
10 p.m.	Arrowroot with or without cream, 6 oz.

The following diet, supplying about 1,600 calories, is recommended by Wegele in gastric myasthenia with reduced secretory activity :—

Morning	Leguminose cocoa, 150 grms.
	Cream, 50 grms.
Forenoon . . .	One soft egg.
	Toast, 20 grms.
Noon	Scraped beef-steak, 100 grms.
	Mashed potato, 200 grms.
	Malt extract, 20 grms.
Afternoon . . .	Leguminose cocoa, 150 grms.
	Cream, 50 grms.
Evening . . .	Tapioca pulp, 250 grms.
	Diastase malt extract, 15 grms.
During the day .	Toast, 50 grms.
10 p.m.	Milk, 200 grms.
	Cognac, 10 grms.

Finally, in the stage of convalescence and for long thereafter, the diet must be simple and spare, and the meals small and slowly eaten. The amount of fluid should be kept in check, 30 oz. being an ample allowance in the twenty-four hours in most cases, 40 oz. being the outside limit.

In the non-obstructive form of dilatation we are concerned mainly with the ensuring of quick emptying of the stomach, and we rest content with intestinal digestion. But in the obstructive form, whatever may be the cause of the pyloric stenosis, our object is to ensure the greatest absorption of food products in the stomach itself. Here peptonized and predigested foods find their chief use. Peptonized milk, somatose, panopepton, Benger's peptonized beef-jelly, Valentine's meat-juice, maltine, and many other preparations are useful. The non-fermentable lactose should be substituted for other carbo-hydrates, and $\frac{1}{2}$ oz. of it can be given in 8 oz. of milk. But dietetic treatment in this condition should only be a temporary measure pending operation.

GASTROPTOSIS

Dietetic treatment can have no influence on the position of the stomach, and any attempt at a cure can only be made by exercises, mechanical support, and surgical treatment. But something can be done to relieve the symptoms. As a rule the actual complaint of the patient arises from stagnation of the contents of the stomach. A sensation of weight, fullness and oppression, and eructation, nausea and vomiting are the usual clinical features. These troubles result in the discarding of one food-article after another, until malnutrition becomes obvious. The aim of dietetic treatment here is the same as in dilatation of the stomach, and we have to provide an adequate supply of food which shall be most easily digested and shall leave the stomach in the shortest time. Efficient mastication and slow eating are of the utmost importance. All meat should be finely minced and rubbed through a sieve. Vegetables such as cauliflower, spinach and asparagus may be allowed. Butter, cream and honey may be taken freely. Meals should be small and frequent, and, as in dilatation, only such an amount of fluid should be taken as is necessary to produce the requisite consistence of the contents of the stomach. In all cases it is important that the patient should lie down for an hour after meals with the thorax at any rate on the same plane as the abdomen, and occasionally further benefit is obtained if the body is slightly inclined to the right side.

In some severe cases when the lesser curvature of the stomach is near the umbilicus, if surgical treatment cannot be obtained or has failed to give relief, the condition is hopeless. One sees women occasionally who have gravitated to a diet of milk, Benger's food and Brand's essence, by taking which at frequent intervals they preserve life without pleasure.

In a few cases, only I think with a moderate degree of descent of the stomach, the actual symptoms depend on hyperacidity, and in these fortunate patients the line of treatment suggested in that condition will commonly give some relief.

GASTRITIS

A. Acute Gastritis

In the common form of acute gastritis the changes are almost entirely limited to the mucosa. The condition is therefore often termed (1) simple gastritis or gastric catarrh. It is thus distinguished from the rarer and more severe inflammations, in which the changes involve a greater depth of the stomach-wall such as (2) the toxic gastritis resulting from the swallowing of irritant poison, and (3) infectious gastritis due to various bacteria, especially streptococcus.

Simple gastritis is marked off from the other common forms of dyspepsia by its acute onset following on some generally recognizable cause, by the prominence of vomiting as a symptom, and by the appearance of mucus in the vomit. It is often associated with a similar condition in the small intestine, and it is sometimes followed by catarrhal jaundice.

In considering the treatment of simple acute gastritis, it is necessary in the first place to understand the origin of the condition, inasmuch as it is generally avoidable; and in many cases it is easy to lay down a few wholesome regulations which will serve to prevent subsequent attacks. It may follow any error of diet. The taking of a large quantity of indigestible or irritating food is a common cause, and an attack is the more likely to occur if this is bolted either from carelessness or as a result of defective teeth. This is a common cause in children. Indulgence in ices on a large scale may produce it. It is a common result of alcoholic debauch, and it is the natural ending which closes each drink-attack of the dipsomaniac. It may be produced by decomposing food, and is then usually associated with a catarrhal enteritis. It is sometimes noted as an early symptom of some specific fevers. Occasionally attacks of considerable severity occur with fever, pain and tenderness, and it is probable that these are of bacterial origin, though they may end in speedy recovery. It is clear that some people have a natural tendency to develop gastric catarrh on slight provocation, and in these more particularly a regulation of diet is important. In the second place it is necessary for the purpose of treatment to realize, that during the acute stage the gastric secretion is scanty and the power of digestion is imperfect or absent for a time, so that complete starvation is both necessary and physiologically correct. Nearly complete rest to the stomach leads to a rapid recovery. This should be obtained without regard to opposition from relatives.

In severe cases with some collapse a few saline injections per rectum may be given, but this is seldom necessary, as abstinence from food need not be maintained for more than a day or two as a rule. Thirst is a prominent symptom at first. Ice, iced water, or iced champagne are often allowed in small doses at this stage; but though they are grateful to the patient, I think it is better to give hot water in teaspoon doses to the amount if necessary of 10–15 oz. in the first 24 hours. The vomiting is not altogether harmful, and it may be disregarded. Alcohol should be avoided, unless it is absolutely necessary in weakly subjects. In 24 or 36 hours feeding may be resumed on a small scale, milk diluted (4 to 1) with lime-water, soda-water or barley-water being tried at first. Of this mixture 20 or 30 oz. can commonly be taken in the first day. From this time onwards it is a matter of graduated increase of food, until a normal full diet can be established. The materials used at first should be milk with a decreasing amount of dilution, albumin-water (the white of one egg stirred up in 10 oz. of water with a little salt) and whey; and to all of these a little brandy or sherry may be added if necessary. As a rule on the fourth or fifth day carbo-hydrates can be added in the form of arrowroot, toast or rusks, and these with 30 oz. of milk (some of it preferably in the form of blancmange), one or two eggs poached or lightly boiled and some beef-tea or clear soup will form a sufficient diet.

About the third day Boas recommends the following diet:—

8 a.m.	Milk (with tea), 200 grms.
	Zwieback, 50 grms.
10 a.m.	Bouillon with egg, 200 grms.
Noon	Milk-soup, 200 grms.
	Toast, 50 grms.
3 p.m.	Milk, 130 grms.
	Cakes, 50 grms.
7 p.m.	Milk-soup with rice, 200 grms.
	Zwieback, 50 grms.

Subsequent extensions by the addition of fish and chicken may be quickly made. At this point if the origin of the attack is clear, final injunctions should be given as regards a healthy diet and the avoidance of future attacks.

In the toxic and infective forms of acute gastritis, both of which involve immediate risk to life, the problem consists in the maintenance of strength with abstinence from food over a much longer period of time. During the early days of imminent danger rectal feeding must be adopted in its most efficient form.

(*B*) Chronic Gastritis

This term was formerly used to denote nearly every form of chronic dyspepsia. Now that the great gastric neuroses and functional disorders are defined and separated off, chronic gastritis, though still an important matter, becomes a comparatively infrequent disease. In practice, however, the old loose usage of the term is still occasionally met with.

As in the case of acute gastritis, prophylactic treatment requires a knowledge of the causation. (*a*) **The primary form.**—It is possible that repeated attacks of acute gastritis may lead to this chronic state, but I believe that this sequence is only met with when the acute attacks are due to alcoholic excess. The causes, however, that have been mentioned as producing acute gastritis are also responsible for the chronic condition, but this chronic gastritis has a slow and insidious beginning and is seldom preceded by acute attacks except in alcoholic subjects. It can be set up by long-continued over-eating and over-drinking, by habitual hurry and food-bolting. The amount and character of the food, and the pace of eating, all play a part. Richness of food, generally synonymous with indigestibility, abuse of spices, condiments and ices, and perhaps of tea and coffee, should be noted. Tobacco-chewing will certainly produce it, and it is thought by some that excessive smoking can contribute to the causation. It is possible that carious teeth may have an influence through the swallowing of bacterial products in pyorrhœa alveolaris as well as through defective mastication. It is said that every one has the stomach which he deserves, and all these causes of what may be termed a primary chronic gastritis are avoidable.

(*b*) **The secondary form.**—But chronic gastritis may be secondary to other conditions. It is especially apt to occur in cirrhosis of the liver. In fact, the most typical examples are met with in that disease. Similarly it occurs as the result of the passive hyperæmia due to cardiac failure, and it often turns the scale in the final stage of valvular disease. It supervenes occasionally in long standing cases of hyperacidity, and some degree of chronic gastritis is commonly present with carcinoma of the stomach. Finally it may appear in various conditions of impaired health, such as tuberculosis, anæmia and chronic nephritis.

It will be seen on reference to the subject of motor insufficiency and dilatation of the stomach, that all these same causes are there in operation. And it is true that, given the same vicious diet or habits, or the same enfeebled health, one patient may develop a chronic gastritis and another a motor impairment and dilatation. It is not possible to separate these two conditions as sharply in practice as in theory, and they often co-exist.

The establishment of a suitable diet requires a knowledge of the state of the gastric secretion. As regards this point, Boas recognizes four varieties : (1) Gastritis acida, (2) anacida, (3) mucipara, (4) atrophicans. As regards the first of these forms, it has been already stated that a chronic gastritis may occasionally supervene on hyperacidity. Putting this uncommon occurrence on one side, we may say that in chronic gastritis the secretion of hydrochloric acid is diminished. On examination the acid is found to be present in combination with protein, but as free acid it is greatly diminished or absent. This deficiency and an increased production of mucus are, in fact, the main clinical features of the disease. In the atrophic variety, a late stage of great rarity, both combined and free acid may be absent, and even the gastric ferments become scanty or cease to appear. In a case of chronic interstitial nephritis with persistent vomiting under my care, the contents of the stomach an hour after a test-breakfast were neutral, and pepsin was entirely absent. Motor impairment is common in chronic gastritis, and some dilatation may take place, but in some cases muscular power is certainly normal, and peristalsis may even become visible.

In slight and early cases the recognition of the cause and its removal may allow a return to health, though a short course of milk diet will probably be necessary. But in severe cases it may be taken as certain that, if the diagnosis is correct, considerable changes have already occurred in the gastric mucosa, and the dietetic treatment will be a long and wearisome process. It should be pointed out to the patient that half measures are useless. He must devote himself entirely to his cure and must retire to bed. Lavage is always necessary.

If there is fair digestive power and free acid is found after a test-breakfast, it is sometimes possible to start with the diet which is suggested as the first step in the treatment of dilatation. But as a rule it is wiser to begin with a milk diet, and I think that milk alone should be given in spite of the disadvantages of its bulk and weight. Forty oz. of milk should be diluted with 8 oz. of lime-water, soda-water or barley-water, and of this mixture 8 oz. may be taken slowly every three hours for 6 doses in the day. It should not be cold, but the patient may have some choice in the temperature. Koumiss or kephir may be used, but many patients dislike them. The duration of this stage must vary with the results, but it is well to proceed very slowly, and a week or 10 days on this 800 calorie diet is certainly not too severe as a rule. If vomiting occurs, it will be necessary to peptonize the milk and to begin with smaller doses. The amount of milk may be gradually increased to 50 oz., and not until this amount can be taken without discomfort should any extension of diet be made. This point may not be reached for two or three weeks.

As regards the next step, it must be remembered that digestion of protein is at a low level and that carbo-hydrates, on the other hand, are apt to undergo fermentation with development of injurious organic acids, though something can be done to check bacterial and toruloid action by medicinal remedies. Both protein and carbo-hydrate food should be added to the diet, but both of these in small quantities. The treatment throughout must be tentative and cautious. Extra protein can be obtained by giving one or two eggs beaten up in milk, or from plasmon, or from raw beef juice, beef-tea, or somatose. The carbo-hydrate element is best given in the form of Benger's food or arrowroot. The following is an outline of such a diet, supplying about 1,200 calories :—

8 a.m.	Milk, 8 oz. with plasmon.
10 a.m.	Milk and egg.
Noon	Beef-tea, 6 oz. or meat-jelly.
2 p.m.	Milk and plasmon.
4 p.m.	Milk and egg or junket and cream.
7 p.m.	Benger's food, 8 oz.
10 p.m.	Milk and plasmon.

Boas recommends the following diet at this stage, amounting to 2,200 calories :—

8 a.m.	Milk and flour soup, 200 grms (milk, 100 grms).
	Bread, 50 grms.
	Butter, 30 grms.
10 a.m.	Eggs, 2.
	White bread, 50 grms., butter, 30 grms.
	Or with this scraped beef, 60 grms.
Noon	Farina milk-soup, 200 grms.
	Milk and rice, 200 grms.
	Prunes, 100 grms.
3 p.m.	Milk and tea or coffee 200 grms. ($\frac{3}{4}$ milk).
	White bread, 50 grms.
7 p.m.	Rice and milk-soup, 200 grms.
	Zwieback, 50 grms.

Later the same diet can be adopted as is recommended as the first step in cases of dilatation of the stomach, eggs, fish, raw meat, toast and butter being permitted, while alcohol, tea, coffee, sugar, spices and condiments are still forbidden. Ewald's diet-list is as follows :—

8 a.m.	Tea, 150–200 grms.
	Stale wheat-bread, toast or zwieback, 100 grms.

10 a.m.	Wheat-bread, 50 grms.
	Butter, 10 grms.
	Cold meat or ham, 50 grms.
	Milk, ¼ litre or one glass of light wine.
2 p.m.	Water, milk, or bouillon of white meats, 150–200 grms.
	Meat or fish, 100–125 grms.
	Vegetables, 30–100 grms.
	Compôte, 80 grms.
4.30 p.m. . . .	Warm milk or chocolate or milk and coffee (half and half) ½ litre.
7.30 p.m. . . .	Soup, 300 grms.
	Wheat-bread, 50 grms.
	Butter, 10 grms.
10 p.m.	Occasionally one cup of coffee and 50 grms. of wheat-bread, biscuit, or zwieback.

In a later stage the final diet recommended in dilatation of the stomach is suitable, a moderate mixed diet in six meals. And from some such diet there should be no hurry to depart. Alcoholic subjects should be urged to become total abstainers. In others a glass of Rhine or Moselle wine may be permitted at lunch and dinner, but under no circumstances should alcohol be taken except with meals.

For chronic gastritis with impairment of digestive power Wegele recommends the following diet, having a value of 2,400 calories :—

Morning	Pepton-cocoa, 150 grms.
	Butter on toast, 25 grms.
Forenoon . . .	One soft-boiled egg.
Noon	Oatmeal soup, 200 grms.
	Fowl, 150 grms.
	Carrot, 200 grms.
Afternoon . . .	Pepton-cocoa, 150 grms.
	Butter and biscuits, 25 grms.
Evening	One egg.
	Scraped ham, 100 grms.
	Macaroni with toasted bread-crumbs, 100 grms.
During the day .	Wine, 200 grms.
	Toast, 75 grms.

For cases with complete loss of digestive power, reference may be made to the food-stuffs mentioned under Carcinoma of the Stomach.

CARCINOMA OF THE STOMACH

The prescription of a suitable diet in carcinoma of the stomach presents great difficulties and no one dietary will suit all cases. But there are certain general principles which should be observed. In the first place it must be confessed that we are dealing with an incurable disease, and consequently great freedom of choice should be allowed to the patient. The fancies and cravings of the patient should be gratified as far as possible. It is curious how, even in an advanced stage, a patient may ask for and digest some article of food which one would have thought was beyond his power. In the second place when the clinical picture is one of pyloric obstruction (cp. obstructive dilatation), we can only aim at ensuring the greatest absorption of nutritive material from the stomach itself, and this is always of small value. Gastro-enterostomy or other surgical measure should be undertaken at once. If this is refused or from any cause is impossible, lavage is the only alternative. Though nutritive material is wasted by lavage, it is better to introduce new absorbable food into a clean stomach than to continually add fresh portions to a fermenting mass. The articles which may be found useful in such cases are: thin toast or rusks, peptonized milk, plasmon and plasmon preparations, somatose, Fairchild's panopepton, Benger's peptonized beef-jelly, Brand's nutrient powder, Carnrick's peptonoids Leube-Rosenthal meat solution, Valentine's meat-juice, kefir or koumiss, Benger's food, Grape-nuts, the "Allenbury" food, maltine, honey, Biedert's cream mixture (4 oz. of cream with 90 grains of lactose) and raw meat-juice. Alcohol should be given if possible, preferably as brandy. A diet can be constructed from these materials which shall allow of some choice on the part of the patient.

In the third place when the pylorus is patent, the conditions are the same as in chronic gastritis, but they are of greater severity and do not contain the same prospect of improvement. In fact some gastritis is commonly associated with carcinoma. Free acid is absent and there is often some motor insufficiency. Though attention may be paid to providing such predigested food-stuffs (mentioned above) as may be most readily absorbed from the stomach, we must realize that gastric digestion is a thing of the past. The administration of hydrochloric acid, pepsin, and gastric stimulants is singularly inefficient. Consequently we must rely chiefly on intestinal digestion and our object is not so much to increase gastric absorption as to ensure by a suitable diet a quick emptying of the stomach. Here also help may often be obtained from gastro-enterostomy. Reference may be made to the diets suggested under the headings of dilatation and chronic gastritis. Alcohol should be added. A mixed protein and carbohydrate diet should be maintained as long as possible.

The following diet giving 1,260 calories may be quoted as recommended by Wegele in cases of carcinoma without pyloric obstruction :—

Morning	Malto-leguminose cocoa, 150 grms.
Forenoon. . . .	Kefir, 200 grms.
Noon	Malto-leguminose soup, 150 grms.
	Scraped beef-steak, 100 grms.
Afternoon . . .	Malto-leguminose cocoa, 150 grms.
Evening	Scraped ham, 100 grms.
	Tapioca, 150 grms.
10 p.m.	Kefir, 200 grms.
During the day .	Toast, 50 grms.
	With the cocoa honey, 30 grms.
	With the kefir cognac, 20 grms.

As an outline of a diet supplying 2,300 calories, which is possible in an early stage of carcinoma, Biedert recommends :—

6 a.m.	Milk, 250 c.c.; toast, 30 grms.
8 a.m.	2 eggs; toast, 20 grms.
10 a.m.	Cream, 125 c.c.; 2 zwieback.
Noon	Meat, 140 grms.; toast, 40 grms.; soda-cake, cinnamon-cake, coffee-cake, biscuit, 25 grms.
4 p.m.	Milk-cocoa, 250 c.c.; 3 zwieback with fruit-jelly.
7 p.m.	Rice-mush, 2 zwieback.
10 p.m.	Milk, 250 c.c.; 2 zwieback.

Finally, in some cases of highly cellular carcinoma with rapid ulceration, from the dietetic point of view the characters are those of gastric ulcer, and hæmorrhage may be a prominent feature. As in gastric ulcer we are compelled to employ rest to the stomach and rectal feeding.

In cases of carcinoma of the cardiac end of the stomach or of the œsophagus, if operation is refused or impossible, it is necessary to depend entirely on rectal feeding. Subcutaneous feeding may be combined with this, but its value is very small. Sterilized olive oil (or sesame oil) 30–40 c.c. may be injected subcutaneously or into muscle with a 10 c.c. syringe at various spots once a day.

FLATULENCE

If flatulence is defined as discomfort arising from an abnormal amount of gas in the stomach with or without eructation of gas, it is a symptom in many conditions. It is so frequently placed in the front of the patient's complaint, that it deserves separate consideration, especially as dietetic measures are generally needed in treatment. For so common a matter, its origin is curiously obscure. In some cases the origin of the gas has never been demonstrated. The cause is often to be found in faulty eating and errors of diet, and these cases are easily rectified, though they are not so easily explained. In other cases the origin is a matter of guess-work and the whole subject presents difficulties.

(1) A considerable amount of air is swallowed with food and saliva. Under normal conditions no discomfort results and presumably the air is passed on into the bowel, though there is no evidence to disprove that it may not also be absorbed by the stomach-wall. Such absorption of gas certainly occurs in the intestine. Flatulence, however, as defined above may be produced from air so swallowed. It is commonly a result of the quick eating of a large meal, especially if large quantities of fluid are taken. A feeling of distension and some gaseous eructation may then be experienced long before the meal is over. Whether more air is then swallowed or whether its normal disposal is prevented by closure of the pylorus or otherwise is uncertain. The remedy is obvious. It is especially important to diminish the amount of fluid taken at meals.

Some people, mostly middle-aged women, are plagued with gastric noises and eructations apart from meals and at awkward times. It has been thought that they have acquired the habit of swallowing air apart from saliva. I have seen nothing to support this theory, and I believe that the gas has the same origin as in some obscure conditions mentioned later. But one cannot help thinking that in these women the noise is quite out of proportion to the amount of gas, and it may be produced in the œsophagus.

(2) In health some CO_2 is added to the air in the stomach by the action of hydrochloric acid on the carbonates of the food and saliva. In disease, especially in conditions of motor insufficiency, gastrectasis and chronic gastritis, this is greatly increased by the fermentation of carbo-hydrates, especially the butyric acid fermentation of which hydrogen also is a product. In slight degree it is a common complaint in the obese. The dietetic treatment has been already described.

(3) In hyperacidity flatulence is often a prominent feature, but its origin is not quite certain. It is possible that when, as often happens in this condition, the flow of saliva is increased the amount of swallowed air may also be increased. It is possible also that there is an increased evolution of gas by the action of hydrochloric acid on the saliva, for as was shown by Sir William Roberts, the saliva in hyperacidity is more alkaline than in health. He found the alkalinity equal to 0·04 per cent of hydrochloric acid. It is not unlikely that gas is regurgitated into the stomach from the duodenum, being evolved there by the action of the excessively acid chyme on the carbonates of the bile and pancreatic secretion. Carbo-hydrate-fermentation may add its quota to the flatulence, for considerable stagnation of the stomach-contents may occur in hyperacidity, and fermentation is always more influenced by delay of food in the stomach than by the degree of acidity reached. In the treatment of hyperacidity these considerations should be borne in mind.

(4) Putrefactive decomposition of protein, which is a normal process in the colon and which occasionally occurs under pathological conditions in the small intestine, is rarely met with in the stomach. It is limited to cases of long-standing and neglected gastrectasis. The gases formed are marsh-gas, hydrogen, carbon dioxide, and sulphuretted hydrogen. It is possible that in some such cases the gases may enter the stomach from the bowels. The diagnosis is not difficult and the line of treatment is plain.

(5) There is a group of conditions, which present flatulence

as a great source of trouble but which perhaps have little else in common. In all of these the stomach may quickly or suddenly become distended with gas. Sometimes only a subjective feeling of distension is produced : more commonly there is actual distension and not only does the area of stomach-resonance encroach on the cardiac area, but the epigastrium is protruded and clothes must be loosened. It may be taken as certain that the gas in these cases is not evolved from any food in the stomach. Its evolution is too rapid, it has no constant relation to meals, it may occur with an empty stomach, and it is sometimes a regular precursor of other phenomena. It is possible that the gas is discharged into the stomach from the bowel, but this is very unlikely inasmuch as there is no evidence in such cases of any intestinal disorder which could lead to such an abundant development of gas. I think there is no other possible explanation than that the gas is CO_2 derived from the venous blood in the stomach-wall, and in the whole group there exist indications of some form of neurosis or nervous disturbance in which the vagus and its branches share.

This form of sudden and voluminous flatulence occurs in some people of nervous temperament, as an isolated phenomenon, occurring at odd times and having no apparent relation with any previous factor or any event to follow. The type of person so affected is, I think, the industrious woman who takes life hardly from choice or necessity. But such an occurrence may be associated with a sense of cardiac oppression and pain or aching in the left arm. It is also a well known precursor of an attack of asthma. I have seen a nurse in whom it often occurred without other symptoms, though it was sometimes followed by a mild pseudo-angina and sometimes by an attack of true asthma.

This same trouble, though less sudden and more lasting, is not uncommon in cardiac failure from any cause. Perhaps the associated venous hyperæmia of the stomach may contribute to it. But it occurs also in valvular disease, both of rheumatic and of arterio-sclerotic origin, when there is no sign of cardiac failure and when nothing in the history or appearance of the patient would lead one to suspect the existence of such disease. A still more serious matter is its occurrence in connexion with true angina. It may be the first symptom of an attack, and if the pain is placed centrally both physician and patient may fall into the error of regarding the case as one of gastric disorder. Apart from true angina, it occurs also in old people with considerable arterio-sclerosis, often in nocturnal attacks, and queer flatulence in such cases should always be treated with respect.

The importance of this group from the dietetic point of view lies in the negative facts that the gas is not evolved from carbohydrates and that radical alteration of the diet is useless. Such treatment as is possible consists in the institution of small simple mixed meals, eaten slowly without excess of fluid, and followed by rest. The evening meal should be a light one. In the old man, who through ignorance retains the eating habits of his youth, some relief may be expected.

DIET IN DISEASES OF THE INTESTINES

CHAPTER XVII

DIET IN DISEASES OF THE INTESTINES

By Herbert P. Hawkins, M.D., F.R.C.P.

General considerations.—Dietetic treatment is not so important in intestinal as in gastric disorder, inasmuch as the common errors of diet produce their effect in the stomach, and the intestine is shielded to some extent. It is more difficult and less exact, because the process of digestion in the small intestine is not fully known. Moreover, we have no direct means of ascertaining the state of the bowel as regards either its secretory or its motor power, and in order to estimate the value of intestinal digestion in any case we must be content with an endeavour to interpret the symptoms and physical signs. Examination of the stools gives some further evidence and it should always be practised. But minute examination is exceedingly difficult, and a rough examination is likely to afford more information as to the state of the colon than as to the digestive power of the small intestine. It is important to realize how completely the bowel is at the mercy of the stomach, and how any impairment of the preparatory and protective functions of the stomach may disturb the action of all parts below. This dependence of the intestine on the stomach is often a serious drawback in prescribing a diet, and an otherwise correct diet must often be modified owing to the coincidence of some gastric failure.

DISEASES ASSOCIATED WITH DIARRHŒA

Our knowledge of diarrhœa, its causes and varieties, is far from exact, but a classification is useful, even though it may not carry us far towards a diagnosis in individual cases.

(1) Diarrhœa may arise from the ingestion of irritating, indigestible or decomposing food. The actual cause of the diarrhœa in such cases will be considered later.

(2) It may result from defective gastric digestion. In most examples of gastric disorder there is constipation, and particularly is this the case in hyperacid states. But diarrhœa is sometimes noted as occurring when the secretion of hydrochloric acid is diminished. This diarrhœa of gastric origin is probably due to the entrance into the bowel of material that has not been sufficiently prepared in the stomach, and it is not improbable that this insufficient preparation consists partly in insufficient disinfection of the food. At any rate an important preparatory and protective function of the stomach has failed.

(3) Theoretically, diarrhœa can result from defects in quantity or quality of bile, pancreatic secretion, and succus entericus. The first two of these secretions are considered elsewhere. Succus entericus probably plays a very important part in intestinal digestion, but little is known of the results that follow its failure. Besides its action on cane sugar and maltose, it seems to reinforce all the ferments of pancreatic secretion. Its alkalinity may also be of use, and a decrease in its secretion may thus have ill effects by allowing increased acidity in the small intestine.

(4) Inflammation of the bowel, catarrhal or croupous, and ulceration of any origin are important causes. Generally speaking the diarrhœa is more violent in disease of the colon than in disease of the small intestine.

(5) The effect of an abnormal growth of bacteria in the bowel, with alteration in numbers, virulence or species (as in typhoid fever, cholera and some forms of colitis) and the effect of toxæmia (bacterial as in septicæmia or toxic as in uræmia) may be allowed.

(6) Finally, we may feel sure that in some cases diarrhœa depends on nothing more serious than a perversion of peristalsis, either of central nervous origin, or as a result of an abnormal sensibility of the intrinsic nervous mechanism in the intestinal wall.

If dietetic treatment is to be accurate, some attempt must be made to utilize these theoretical considerations. But there are many difficulties. These causes often interact, they may be conjoined in various groupings, and one may lead to another, so that they defy analysis.

No doubt diarrhœa can result from chemical or mechanical irritants such as mercury, decomposing meat or a meal of unripe apples. But it is exceedingly likely that even such simple causes produce their effect not directly but through bacterial agency, and that the bacteria normally present in the bowel undergo rapid development upon the introduction of such material. At any rate I think it must be allowed that whenever there is actual inflammation of the intestinal wall the immediate cause is the abnormal growth of bacteria and the products of their activity. It appears from Strasburger's observations that in all forms of diarrhœa the output of bacteria in the stools is greatly increased. The weight (dried) may reach 14 grammes or more per diem, as compared with an average of 8 grammes in health. Consequently the dietetic treatment of diarrhœa is largely bound up with the question of the possibility of influencing bacterial growth in the intestine by alteration and manipulation of food.

Roughly speaking there are two classes of bacteria in the bowel, each of which occupies its own territory. In the small intestine the bacteria are mostly such as produce organic acids (lactic, acetic, and succinic) by their action on carbo-hydrates. The lower two-thirds of the colon hold the bacillus coli communis, and other protein-decomposing organisms. It seems to be established that both classes inhabit the cæcum and first part of the colon: at any rate bacterial fermentation of carbo-hydrates has been demonstrated in this intermediate area. Only under pathological conditions do the protein-decomposing bacteria of the colon appear or become obviously active above the ileo-cœcal valve.

As regards the colon it must be remembered that here digestion proper is at an end. I do not think that the character of the food can have any material influence on bacteria of the colon, save indirectly by the choice of a diet leaving little residue and containing no hard or irritating particles.

But as regards the small intestine it is probable that diet has some influence on bacterial growth, though it does not follow that we can use this influence satisfactorily in practice. In consequence of the steady production of acids by bacterial action on carbo-hydrates, the contents of the small intestine remain acid, notwithstanding the constant neutralizing effect of the alkaline succus entericus. It seems probable that this acidity has its use in restraining the growth of putrefactive protein-decomposing organisms, which, normally inhabiting the colon, might otherwise overrun and flourish in the small intestine. It is clear that under abnormal conditions such an invasion by putrefactive bacteria does actually occur. It is probable that by an increase of the carbo-hydrate element in the diet we can increase the degree of this protective acidity in the small intestine. In fact, the stools which are normally alkaline may become faintly acid on a free carbo-hydrate diet. There are cases in which a milk-carbo-hydrate diet based on these considerations should be used. Theory and practice, however, are not always in agreement. And it must be realized that beyond a certain point the increased acidity, with the inevitable development of gas, may itself act as an irritant and lead to increased peristalsis and frequent stools. This is the source of the gas in most cases, when intestinal flatulence is the chief complaint.

In fact, this state of excessive fermentation and acidity in the small intestine can be recognized with some certainty. Diarrhœa, colic and flatulence are its chief features. The term "acid jejunal diarrhœa" has been applied to it by Nothnagel.

It is probable also that a similar excess of acidity of a more complex type may arise through deficiency of the alkaline succus entericus, which is a specialized secretion and is likely to fall off in amount under inflammatory conditions. Schmidt and Strasburger recognize an "intestinal fermentation dyspepsia" as having such an origin. The symptoms of this condition are obscure pain in the abdomen, fullness and hyperæsthesia of the abdomen, a feeling of malaise, loss of appetite, furred tongue, and frequent loose stools, the fæces being frothy, yellow and acid, but containing no mucus.

It will be seen, therefore, that there are cases of diarrhœa where the fermentation in the small intestine becomes undesirable. Rapid improvement will sometimes occur when milk and carbo-hydrates are dropped and protein-feeding is begun.

It must not be thought, however, that the influence of diet on the intestinal flora turns only on the rise and fall of the activity of the acid-producing bacteria in the small intestine. The conditions are probably far more complex, though it is impossible to trace their effects with accuracy. It is probable that other factors exist, such as the consistence of the food, the amount of fluid taken, the nature and number of the bacteria taken with the food, the value of the upper digestive secretions, and the motor power of stomach and intestine. An example showing the complexity of the problem is given by the undoubted fact that the stools in jaundice are often loose and offensive, and suggest that an abnormal bacterial decomposition of protein is taking place. It is certain that this condition is not due, as was thought at one time, to the loss of some antiseptic property contained in the bile. It is probably due to the fact that the normal pancreatic digestion of protein is in some way interfered with by the excess of fat which in the absence of bile escapes absorption. This interference is possibly of the nature of a mechanical envelopment of protein-particles by fat. At any rate in jaundice with loose stools fat should be discarded from the diet.

I think that in most cases of diarrhœa (except perhaps those of purely nervous origin) dietetic treatment involves (1) a recognition of the cause, (2) a choice between a milk-carbo-hydrate and a protein diet. This choice must be made on the lines indicated above. The decomposition of protein is best met by a milk diet or a milk-carbo-hydrate diet in which milk is the chief article. On the other hand, irritative and inflammatory conditions of the small intestine require a reduction of carbo-hydrates and their replacement by protein and fat. But it must be confessed that in many cases the guides are uncertain and the best treatment must come from experience. Particularly is this the case in the various ulcerative conditions of the bowel.

A pure milk diet is sometimes of use, but there is no reason to believe that it has any influence upon intestinal bacteria, except in so far as the bacterial fermentation of the contained lactose may tend to maintain the acidity of the small intestine. I think its merit lies in the small residue which enters the colon, and it is in diseases of the colon that it finds its chief use. Koumiss and kephir may be similarly used.

Finally, in all forms of diarrhœa it is well to avoid all articles containing cellulose, vegetables, fruit, coarse bread-stuffs and grains, sugar, and meat-extracts.

Though we may draw up a list of the conditions under which diarrhœa occurs, we have no working classification. Certain forms of diarrhœa, however, stand out as having some constant characters.

A. Catarrhal Enteritis

For the causes of this condition and for the prophylactic treatment based on a knowledge of these causes, reference may be made to catarrhal gastritis. The gastric and the intestinal disease arise in much the same way and they are often combined. But as might be expected from its position at the upper end of the alimentary canal, the stomach usually suffers first, and in greater degree. Toxic substances, however, in decomposing food may produce their greatest effect in the small intestine, the stomach escaping or being but slightly affected. Catarrhal enteritis may certainly arise under some unintelligible weather conditions, and little epidemics thus occur, presumably of bacterial origin.

Acute catarrhal enteritis is easily recognized. Its sudden beginning, often following a recognizable cause, its violence and the rapid recovery are characteristic features. Repeated attacks may occur, and some patients show a special liability. A chronic catarrhal enteritis is by no means common. The term was formerly applied to nearly every form of chronic intestinal disorder, but increasing knowledge has narrowed it down to a comparatively infrequent occurrence.

In the acute condition, if the stomach is simultaneously affected, abstinence from food should be practised as in acute gastritis. When diarrhœa is the prominent symptom from the first, food and drink may be given, but should be such as to leave little residue. Albumin-water and whey, with cold tea or barley-water to relieve thirst, are most suitable in the first stage. To these, brandy or sherry can be added if necessary. Raw meat-juice may also be needed in some cases.

As regards the next step, in slight cases the tendency to recovery after complete evacuation of the bowel is so strong that we may proceed rapidly by the addition of milk diluted with lime-water, and carbo-hydrates such as Benger's food, arrowroot, toast and rusks. Later eggs, pounded fish and sweetbread can be given with further varieties of starch, so that a plain full diet is often reached in a few days. The subsequent diet should be regulated with the idea of avoiding a recurrence.

But some cases are more prolonged and greater care is necessary. Though we speak of catarrhal enteritis as a clinical entity, it is probable that bacteriological varieties are included under this head. An important difference is to be noted in the character of the stools. They may be almost of rice-water appearance and nearly odourless, or they may be exceedingly offensive and suggest putrefaction of protein-material. In the former case it may be well to withhold milk and to allow very little carbohydrate until the trouble is abating. The diet then will consist of albumin-water, whey, raw meat-juice, panopepton (which may be made into a jelly) barley-water, tea, arrowroot made with water and boiled flour-gruel, in all of which alcohol can be given, if required.

Various irregularities of the bowels are grouped together under the term " chronic catarrhal enteritis " on the authority of Nothnagel. There may be difference of opinion as to their nature and there may be a strong suspicion of a nervous element in some of them, but they are recognized conditions. Briefly, there are included here, (1) cases in which constipation regularly alternates with diarrhœa, the diarrhœic stools being thin or soft, mixed with mucus and attended with pain, (2) cases in which there is a daily evacuation of unformed and pultaceous fæces, and (3) a continuing diarrhœa attributed by Nothnagel to an irritating excess of acidity in the small intestine, which occasions increased peristalsis, so that the contents of the small intestine are hurried to the anus, as is shown by the presence of unaltered bile-pigment in the stools.

In all such cases an attempt must be made to ascertain the actual defect, bacterial or otherwise, on which the diarrhœa depends. I doubt if the origin and nature of this group are sufficiently constant to warrant any dogmatic statement as to an appropriate diet. The history must be carefully examined. In chronic cases something can be learnt from the experience of the patient. He has often found out for himself the relative merits of a milk-carbo-hydrate and a protein diet. In every case the articles, which have been already mentioned as being harmful in diarrhœa, should be excluded. Certainly in some cases of continuing diarrhœa improvement will set in on such a nearly pure protein diet as the following :—

8 a.m.	Cocoa made with water, one or two eggs.
10 a.m.	Bouillon with an egg.
Noon	Chicken or fish, piece of toast, custard.
	Claret glass of Burgundy.
4 p.m.	Panopepton, one egg, piece of toast.
7 p.m.	Sweetbread, chicken, or fish, piece of toast.
	Claret glass of Burgundy.
10 p.m.	Raw meat sandwiches or panopepton.

The diet recommended by Wegele may be quoted :—

Morning	Cocoa, 200 grms.
	One egg.
Forenoon . . .	Kefir (4 days old), 240 grms.
Noon	Soup, 250 grms.
	One egg.
	Roast chicken, 150 grms.
	Mashed potato, 250 grms.
2 p.m.	Cocoa, 250 grms.
6 p.m.	Kefir, 250 grms.
8 p.m.	Soup, 200 grms., one egg.
	Sweetbread, 100 grms.
10 p.m.	Kefir, 250 grms.
During the day .	Zwieback or toast, 75 grms.
	Butter, 20 grms.
	Whortleberry wine, 250 grms.

B. Nervous Diarrhœa

This condition seldom needs any elaborate dietetic treatment, but it may be mentioned here as contrasting with the chronic inflammatory state already described with which confusion is possible. It is by no means uncommon. Its oddness should lead to its recognition. Though we can only guess at the actual mechanism by which in this condition an evacuation of the bowel is so mysteriously evoked, no one can doubt that it is of nervous origin, and that the intestine, apart from its intrinsic nervous mechanism, is perfectly healthy. The motor element predominates, but in some cases it seems certain that there occurs also at times a sudden influx of fluid into the bowel, either serous fluid or succus entericus. Many forms are met with. In some people, whose bowels act regularly, a hurried uncontrollable stool will occur under shock, emotion, fright, excitement, or even the ordeal of speaking in public. Such a stool, moreover, may be profuse and liquid. In other cases the bowels habitually act two or three times in the day at irregular intervals, and such patients complain of the violent (though painless) peristalsis and the noisy gurgling that attend such evacuations. The seriousness of this state lies in the fact that any unwonted hurry, annoyance, or excitement means a call to stool. Even the knowledge that no lavatory is at hand may be sufficient to produce distress. The opium or morphine habit is often the result. Frequent as the stools are in such cases, they are curiously bulky. All the instances that I have seen were in strong men who betrayed no other neurotic tendency, and in some of these the trouble began in boyhood. There are some people in whom certain articles of food will quickly excite purging. Verification is easy and dispels the doubt that this story at first inspires. Finally lientery is a genuine ailment. It appears as if the entrance of food into the stomach excites a general movement throughout the whole intestine, and sometimes every large meal is immediately followed by an action of the bowels. This condition is not as a rule continuous, but it occurs in bouts which yield to treatment.

As regards the dietetic treatment of these various forms of nervous diarrhœa, it may be said that in one form the patient is the best judge, and that in the others nothing can be done except the establishment of a healthy diet, regular hours, and an increase of confidence.

C. Colitis

(*a*) **Primary.**—The colon no doubt is often affected as well as the small intestine in the catarrhal conditions already described. But in some cases the physical signs and the appearance of blood and mucus in the stools indicate affection of the colon alone. Numerous varieties are described, but they cannot be classified. Nothing is known as to its causation, but it can hardly be doubted that it is of bacterial or parasitic origin. It is possible that some instances of it own the same cause as ulcerative colitis, and that they may be regarded as slight attacks of that disease, differing from it only in degree, in the slightness or perhaps even the absence of ulceration. Occasionally a previous history of such attacks ending in recovery is obtained from patients suffering from the fully developed ulcerative disease, and I think that the unusually long story of some cases of ulcerative colitis is thus explained. The occurrence of such slight attacks strengthens the general view of the identity of ulcerative colitis with bacillary dysentery, in which similar grades of severity are observed.

(*b*) **Secondary.**—Colitis is readily set up by errors of diet in those who have previously suffered from dysentery. It occurs under many conditions of severe illness, such as septicæmia, toxæmia of any kind, renal disease and pneumonia.

In all cases, primary and secondary, milk alone is permissible, either diluted (4 or 6 to 1 of lime-water, soda-water or barley-water) or as blancmange made with isinglass. It is starvation diet, but 70 oz. (1,400 calories) may be given and occasionally even more. Any departure from a milk diet should be postponed as long as possible. The final additions to the diet should be a small allowance of carbo-hydrate (especially Benger's food) the yolk of eggs, and plasmon. A return to meat, meat-extracts and vegetables must be made with the greatest caution.

D. Intestinal Ulceration

Three of the various forms of intestinal ulceration need to be considered in relation to diet. As regards ulcerative colitis nothing need be added to the recommendations made in the preceding section. As far as possible milk alone should be given. The same recommendation applies to those cases of carcinoma of the colon, of which ulceration, rather than stenosis, is the chief feature with diarrhœa and bleeding. As regards tuberculous ulceration, it is held by some, I believe with truth, that if profuse diarrhœa is the chief symptom, we may feel sure that the colon is at any rate as much affected as the small intestine. In such cases I think a milk-carbo-hydrate diet affords the best chance of relief. Of carbo-hydrate foods rice, tapioca, and arrowroot are to be preferred. But it is possible that, when the small intestine is chiefly diseased, the acid fermentation resulting from such a diet may have an irritating effect. Though milk need not be entirely withheld, it may be well to try the effect of replacing the carbo-hydrate element by protein food.

CONSTIPATION

Constipation is due to many causes, which are separate or combined, and every case requires examination before dietetic treatment can be considered. It is very commonly present in association with gastric disease of all kinds, often owing to the diet which is necessary in such disease, sometimes perhaps owing to an atonic intestinal condition which is associated with a similar state of the stomach. Generally speaking it is more common with hyperacid than anacid conditions. It may depend on defects of any of the intestinal secretions. It occurs in all manner of conditions in which the general health and nutrition is impaired, as anæmia, fever, neurasthenia and debility. Painful conditions of the anus produce it. In some cases one can hardly doubt from the history that it has been present from birth, and is the outcome of a congenital neuro-muscular defect in the colon. It is often aggravated by enteroptosis. Its association with mucous colic and enterospasm is referred to elsewhere. But constipation produced by these and such-like causes forms a very small part of the disease. As a rule it is the direct result of a defective diet, and contributory causes are to be found in other avoidable adverse conditions, such as a sedentary unhealthy life and matutinal hurry.

The main error is one of diet. The condition of the nervous mechanism on which defæcation depends is a matter of the greatest importance. In some cases we must conclude that it has been sluggish from birth. More commonly it shows signs of failure in early adult life. Sometimes it seems to become defective only in old age. We have no certain means of raising its excitability and power, but much can be done by an appropriate diet to provide an increase of stimulus to its action.

For the due performance of the function certain things are necessary. We may presume that the actual cause of peristalsis is either, (1) direct excitation of movement by mechanical distention of the bowel by solids, fluids or gas, or (2) a local reflex action (subject to central nervous control) set up by chemical stimulation of the sensory nerves in the mucosa. Probably both forms of stimulus are at work. For the former a certain bulk of residue after digestion is necessary, and this will obviously vary greatly on different diets. Of milk 2,438 grm. produced 96 grm. of fæces with a dry residue of 24·8 grm.; of meat 1,435 grm. produced 64 grm. with a dry residue of 17·2 grm.; of black bread 1,360 grm. (roughly 46 oz.) produced 815 grm. with a dry residue of 115·8 grm. (Rubner). Rapid distension of the bowel excites strong peristalsis, and is often attended with pain. As regards chemical irritation, there is every reason to believe that the acids produced by bacterial fermentation of carbohydrates and cellulose are the important factors. Certainly, as is mentioned in connexion with diarrhœa, violent and painful peristalsis may be produced by excessive acidity. But probably the products of the decomposition of protein by bacteria, which normally occurs in the colon, are also to be regarded as stimulants of peristalsis in that part of the bowel. And it is a noteworthy fact in this relation that, as Strasburger has shown, the average daily weight of dried bacteria in the stools is only 5·5 grm. in constipation, as compared with 8·0 grm. in health. Perhaps it may be concluded from this observation that protein-decomposition is actually less in constipation than in health. This is certainly in agreement with clinical experience. I think the evil effects of constipation, the toxæmia, anæmia and malnutrition which are often ascribed to it, are greatly exaggerated. There are no facts which will justify the use of the term "auto-intoxication" in this connexion.

Though no statistics are available, it will be generally allowed that constipation is increasingly prevalent in the upper classes. It is probable that this tendency is mainly due to the steady intentional elimination from food-stuffs of all particles which are not nutritious. In this way the bulk of the residue is diminished. Further, it is possible that there has been an undue substitution of protein for carbo-hydrate material, which results in a decreased formation of organic acids and gas.

That defective diet is an important factor in the production of common constipation is shown by the good result which sometimes quickly follows the resumption of simple and less artificial food. But such an immediate result is seen only in slight cases of short duration. In the majority of patients who seek help the trouble is of long standing, aperients have been freely used, and the reflex is blunted or lost. In such cases no immediate benefit results from the establishment of a proper diet, and it is consequently often dropped as useless. It is wise, therefore, to be beforehand and to explain to the patient that the diet will at first produce no obvious effect, but that it must nevertheless be considered (with slight variations) as a permanent régime, while dependence is placed on massage, electricity and improvement of life-conditions to wean him from aperients.

The alterations which are generally necessary in the diet are an increase of cellulose, a decrease of meat, an increase of fat, a sufficiency of water, and an avoidance of astringents.

Consequently Graham or whole-meal bread should be substituted for white bread. Porridge is useful, especially Scotch oatmeal and Quaker oats. Vegetables such as cabbage, sprouts, scarlet runners, tomatoes, haricots blancs, salsify, Spanish onion and asparagus should be freely used, though the two last are unsuitable in some cases. Fruit should be taken at least three times a day, the most useful varieties being apples, baked or raw, pears, currants, raspberries, cranberries, prunes, dates and figs. Butter should be taken at all meals. An increase of fat in the dejecta is a material aid. Many people have a strong aversion to oil. If it can be taken, olive oil is certainly of use, even in such small quantity as is commonly employed with salads. But if there is no such aversion, it should be taken more freely either with salads or alone. I think that the patient is fortunate, though rare, who can take one or two tablespoonfuls of olive oil three times a day. The free use of water should be insisted on. It is thought by some that cold water is more efficient than hot. Tea should be avoided. There is no reason to forbid alcohol, but the choice should be limited to whisky diluted with soda-water, or Hock or Moselle wine, and even these latter may well be diluted with one-sixth of soda-water. Cider is often recommended, but it is not always welcome at meals. Light lager beer is a harmless drink.

An outline of a wholesome diet is appended. But in the treatment of constipation it is necessary to suit the diet to the patient and to make allowance for idiosyncrasies which we can recognize without understanding. It is quite possible at first to overdo the alteration in the diet and to forget that a cure must be the work of time. Though many patients can take vegetables and fruit in abundance, others experience considerable discomfort from the intestinal flatulence engendered by bacterial action upon the cellulose. Though this is not an unmixed evil, it may necessitate some modification in the diet. Again, if obesity co-exists with constipation, as often happens, the carbo-hydrate allowance must be reduced, and protein, and if possible more fat must be added. Further, it is obvious that the dietetic treatment of constipation may be rendered difficult or impossible by the co-existence of some form of dyspepsia or actual gastric disease.

DIET FOR CONSTIPATION.

Half an hour before breakfast 10 fluid oz. of hot water with a small dose of Carlsbad salt (dissolved in it) insufficient to produce an obvious aperient effect: or the juice of an orange made up to 10 oz. with cold water.

Breakfast . . .	Coffee with milk and sugar, 10 oz. (or cocoa).
	Graham or whole-meal bread or toast, 3 oz.
	Porridge with milk or cream (2 oz. of Scotch oatmeal).
	One egg (or fish or fat bacon).
	Butter, 1 oz.
	Honey, ½ oz. (or treacle or home-made marmalade).
	Two apples baked or raw (or bananas, pears, and other fruit in season).
Lunch	Bread or toast as above, 2 oz. (or whole-meal biscuits).
	Fish, 2 oz. (or chicken or meat).
	French beans, 4 oz. (or Spanish onion, celery, cabbage, Brussels sprouts).
	Salads with oil, 2 oz. (lettuce, potato, tomato, beetroot).
	Stewed fruit with cream, 2 oz. (prunes, figs, apple-charlotte or purée).
	Butter, ½ oz.
	Lager beer, 10 oz. (or cider, Hock, Moselle, Berncastler).

5 p.m.	Coffee, milk, and sugar, 8 oz.
	Bread, toast or whole-meal biscuits as above, 2 oz.
	Butter, ½ oz.
Dinner	Clear soup, 6 oz.
	Otherwise as lunch.
Bed time . . .	Water plain or aerated, 10 oz.
	Whole-meal biscuit.

A diet recommended by Wegele is as follows :—

Morning	Milk and coffee, 200 grms.
	Butter, 30 grms.
	Honey, 30 grms.
Forenoon . . .	Buttermilk, 300 grms.
Noon	Bouillon, 200 grms.
	Mutton, 200 grms.
	Cabbage, 300 grms.
	Plums, 200 grms.
	White wine or cider, 300 grms.
Afternoon . . .	Buttermilk, 300 grms.
Evening . . .	Meat, 150 grms.
	Butter, 30 grms.
	Stewed apples, 300 grms.
	Graham bread, 250 grms.
After evening meal	Lager beer, 750 grms.

ENTEROSPASM

Common constipation, due to sluggishness of the intestinal movement and of the rectal reflex, is painless. There may be some slight sensation of discomfort, but there is no pain. Constipation produces its undoubted effect on the consciousness by the feeling that a necessary function is in abeyance or is imperfectly performed. When pain or aching is experienced, I think it is probable that a spastic condition of the colon is present. Such pain is often associated with mucous colic, and enterospasm is, in fact, the chief cause of the pain in that condition. But enterospasm, a pure motor disturbance, may occur without the conjoined secretory perversion, which is characteristic of mucous colic, and from its long duration and its profound effect on the mental state it is a matter of some importance. The pain or ache may be felt at any part in the course of the colon, but it is most common in the right or left iliac fossa, and in the former position it may arouse a suspicion of disease of the appendix.

To the patient enterospasm is constipation, and constipation is his complaint. When spasm is present, it is even more necessary than in common constipation to be chary in the use of purgatives. Without entering into details as to the best line of treatment, it may be said that dependence must be placed on general measures, such as diet, massage and regulation of the life and habits, and that little good (and sometimes even harm) will result from any attempt at energetic treatment applied to the interior of the bowel.

As in the case of mucous colic, a rather coarse cellulose diet should be aimed at, but it must be carefully adapted to the patient. Occasionally the diets that are suggested elsewhere for constipation and the less severe forms of mucous colic can be borne, and will prove of service. They should be given a full trial with the intelligent co-operation of the patient. But in consequence of flatulence and discomfort the amount of cellulose must often be diminished, and recourse should be had to the second diet recommended for mucous colic. Butter and oil are extremely useful, and every effort should be made to overcome the distaste for olive oil which is so commonly experienced.

MUCOUS COLIC

(Syn. Mucous colitis, Muco-membranous colitis)

The diet in this condition is an important part of the treatment. From the evidence I think we must regard the conditions as a perversion of secretion, a secretion-neurosis. If any actual change in the colon-wall occurs, it is of secondary origin. But, as is seen from the synonyms above mentioned, the alternative view of an inflammatory origin was held at one time, and perhaps it is still in existence. From the dietetic point of view this difference of opinion is of some importance. On the inflammatory hypothesis one could hardly recommend the coarse diet which experience shows is often of service.

The belief in the neurotic explanation is founded on the peculiar temperament which (like that associated with asthma) is characteristic of the patient, on the known fact that an attack of mucous colic may be precipitated by shock or emotional disturbance, on the negative findings in the few cases in which an opportunity for post-mortem examination has arisen, and on the fact that in no definite inflammation of the colon is there any such abundant appearance of mucus as is commonly seen in even slight cases of this disease. The inflammatory explanation arose from the *à priori* idea that excess of mucus must mean catarrhal inflammation.

Mucus is the natural lubricant of the colon, and its secretion in due amount is necessary for the passage and expulsion of fæces. I think a diminution or absence of mucus is a small contributory factor in some cases of constipation. Mucus is often seen in small thin pellicles upon hard scybala, and in such cases its excessive secretion may be taken as a natural purposeful process, and it is not disease. Excessive mucus-secretion becomes a disease when it is purposeless and out of proportion to any lubricating effect required. In many cases painful enterospasm is associated with this secretory perversion.

Without attempting to describe the whole condition, it may be said in brief that two classes of cases can be recognized. The distinction is useful in determining the line of treatment. These two classes, however, are not separate. They represent the two extremes of one scale. There are intermediate grades, and in regulating the diet the position of individual patients must be appreciated. In nearly all cases constipation is a prominent feature.

In the first class are cases which may be considered as a pure secretion-neurosis. With obstinate constipation there is the passage from time to time of considerable quantities of mucus, generally as small sheets, pellets or masses, seldom as tubular casts. There is discomfort or aching in some part of the course of the colon, generally on the left side, seldom amounting to actual pain, which if it is long continued obtrudes itself more and more upon the consciousness, and may induce hypochondriasis. Such a condition is often of long duration; it may be continuous for months at a time, and sometimes, with intervals of peace, it is spread over several years. In this case constipation is the main trouble, and it is aggravated by most aperients.

In the second class are cases to which the term mucous colic is more correctly applied. With the secretory perversion there is associated motor and sensory disturbance. There is added evidence of violent spasm of colon, probably combined with inhibition in other sections of the bowel. The case presents a history of attacks of pain, generally on the left side, always severe, sometimes so severe that colotomy has been performed. With each attack is the production and passage of large quantities of mucinoid material, often in tubular casts, sometimes in rods, which on transverse section and microscopical examination show evidence of having been subjected to compression. The stools at this point may be exceedingly frequent. Some oozing of blood may occur as the casts are detached. True intestinal sand (mostly calcium carbonate and phosphate) is occasionally found in the stools. After long treatment by a coarse cellulose diet this appearance of sand may be imitated by vegetable residue. Such attacks last for a few days, and occur at varying intervals. During the intervals there may be fair health, but constipation is generally a source of trouble.

Two opposed lines of dietetic treatment are recommended by different schools in this condition, viz.: a coarse cellulose diet (von Noorden), on the one hand, and a diet leaving a scanty residue on the other. This apparent divergence of practice seems to be explained by the differences which have been mentioned in the form of the malady. At one end of the scale we have cases of constipation and mucus-passing, in which the constipation is the most important matter. At the other end are cases which, though they are in other respects identical with the first group, present pain as the prominent feature, such pain, moreover, as would legitimately need morphia for its control in any other than this neurotic class of patient. I think that both plans, the coarse diet and the bland diet, have their uses, and that each case must be treated according to its prevailing character.

If the case approximates to simple constipation with mere excess of mucus and little or no evidence of spasm, a diet such as is recommended in constipation may be found equally suitable here. And the same diet may sometimes be used during the quiescent intervals of fair health in those patients who suffer from paroxysms of pain and mucus-passing, if these intervals are of sufficient duration. In all cases an attempt should be made to diminish the use of meat and to substitute a larger allowance of fat, and it is important to ensure that an abundance of fruit is taken.

I doubt if many cases occur in which it is wise to employ von Noorden's diet in its full severity. It consists of "half a pound of Graham bread, all manner of leguminous vegetables, including the husks and all vegetables containing much cellulose, fruits, especially those which have thick skins and seeds, such as currants, gooseberries and grapes, with large quantities of fat, butter and bacon." With such a diet he reports a permanent cure in 50 per cent and incomplete success in 28 per cent.

The following is an outline of a modified cellulose diet :—

Modified Cellulose Diet in Mucous Colic.

Half an hour before breakfast, 8 oz. of hot water.

Breakfast . . .	Milk, 8 oz. (or cocoa made with milk. Graham or whole-meal bread or toast, 3 oz. Butter, 1 oz. Honey, ½ oz. One egg (or fat bacon). A baked apple (or fruit in season, pears, currants, gooseberries, blackberries, raspberries, grapes).
Lunch	Scrambled eggs (or savoury omelette). Bread or toast as above, 2 oz. Butter, ½ oz. French beans, 4 oz. (or artichokes, beet-root, parsnips, turnips, cabbage). Water plain or aerated, 8 oz.
5 p.m.	Freshly made tea with half milk, 8 oz. Bread or toast, 2 oz. Butter, ½ oz.
Dinner	Milk-soup, flavoured with celery or turnip, 6 oz. Fish (sole, plaice or whiting), 3 oz. Vegetables as at lunch. Apple-fritters or purée with cream (or stewed apples, prunes, figs). Bread or toast, 2 oz. Butter, ½ oz. Water as at lunch (or whisky diluted 6–1).
Bed time . . .	Water plain or aerated, 8 oz. Toast or whole-meal biscuit.

In the more severe type of case in which pain is the chief feature, occurring either continuously or in frequent attacks, I think that the diet must be modified so as to lessen the amount of residue that shall enter the colon. In such cases a very coarse cellulose diet will sometimes even precipitate an attack, or at any rate is apt to increase the discomfort. Milk should be used in some quantity. The following scheme may be of use :—

Diet in more Severe Type of Mucous Colic.

Half an hour before breakfast, 8 oz. of hot water.

Breakfast . . .	Milk (perhaps slightly diluted), 8 oz. White bread or toast, 3 oz. Butter, 1 oz. Honey, ½ oz. Baked apple with cream.
11 a.m.	Milk hot or cold, 8 oz.
Lunch	Milk soup flavoured with vegetables, 8 oz. Milk-pudding, especially rice, tapioca or macaroni (or custard), 2 oz. Bread or toast, 2 oz. Butter, ⅔ oz. Water plain or aerated, 6 oz.
5 p.m.	Freshly made tea with half milk (or cocoa), 8 oz. Bread or toast, 1 oz. Butter, ⅓ oz.
Dinner	Lentil-soup (or milk-soup), 6 oz. Fish, 3 oz. Potato-purée (or potato-salad with oil), 2 oz. Spinach or cauliflower, 2 oz. Milk pudding with cream (or blancmange with fruit-juice), 2 oz. Bread or toast, 1 oz. Butter, ⅓ oz. Water plain or aerated, 6 oz.
Bed time . . .	Milk, 6 oz. Rusk.

Finally, there are cases of still greater severity. Paroxysms of pain and mucus-passing are long and frequent. The outlook is sometimes so hopeless that a right-side colotomy has been performed. Periods will then occur in which the diet must be still more simple, and the residue entering the colon must be still further reduced, although constipation is thereby increased. Milk diluted with lime-water or as blancmange, or flavoured with coffee should be the main article of diet. It may be strengthened with plasmon. Eggs lightly-boiled or as custard may be taken in some cases, with carbo-hydrate food, in the form of toast, rusks, arrowroot, rice or tapioca.

Though the principles involved in the preparation of the diet in cases of this disease may be theoretically correct, the practice is beset with difficulty. Modifications must often be made to suit individual patients. The difficulties are often greatest in those who are least ill. As in the case of common constipation, the expectation entertained by the patient as to immediate benefit from the diet is usually placed too high. This should be explained at the outset. Some patients, for whom the full cellulose diet would seem entirely suitable, are unable to continue it owing to the flatulence produced. Other points must be considered and allowed for, or in some cases disregarded. The general state of nutrition must be considered. These patients are generally ill-nourished, but continued loss of weight may require at first a simple diet of milk, carbo-hydrates and fat (with massage), to which articles containing much cellulose may be subsequently added by degrees. In some cases there is associated with the colon-condition a gastric neurosis, of such a character that genuine pain in the stomach is produced by all but the simplest and most digestible articles of food. Considerable inanition and feebleness of body and mind may follow. A gain of weight is a hopeful sign. Moreover, the patient who suffers from this colon-neurosis in its slighter grades is the very type of person who quickly declares that such and such articles of diet cannot be taken but always disagree. While a real idiosyncrasy as regards food-stuffs does certainly exist, in most cases these likes and dislikes are due to preconceived and baseless ideas. They are the more troublesome, inasmuch as the patient's wish to get well is often curiously ill-developed, and they must then be ignored. Finally, an insuperable difficulty may be met with in the association of such a degree of gastroptosis as will forbid any attempt at a curative diet.

APPENDICITIS

In cases which are seen and recognized from the first, food should be given sparingly. The ideal state, in which a perforative lesion of the appendix may be best sustained, requires an empty, motionless stomach and a stationary intestine. The dissemination of bacteria throughout the abdominal cavity is greatly influenced by the degree of peristaltic activity. Starvation is the lesser of two evils. In every case, however slight the early symptoms may be, the treatment should be conducted on the hypothesis that perforation or gangrene has certainly occurred. Such fluid, however, may be given as will serve to maintain the secretion of saliva. A complaint of thirst should not lead to extravagance, and it may be met if necessary by small injections (6 oz.) of saline solution by rectum. Water hot or cold (the former if there is much vomiting), in 1 oz. doses every hour is ample at this stage, or a similar amount of barley-water or of milk diluted with one-half of soda-water. If the patient is fortunate enough to come under treatment at the onset of symptoms and the appendix is at once excised, the subsequent feeding will be conducted as after any other abdominal operation.

If the first 48 hours have elapsed without operation and without signs of general peritoneal infection, milk can be given in greater quantity, perhaps 4 oz. diluted (4–1) with soda-water every 2 hours for 9 doses in the day. And there should be but little extension of this diet in the next few days, during which observation is directed to the appearance of signs of localized suppuration or of a late general infection of the peritoneum. When this period of danger is past, the diet can be rapidly increased by the addition of more milk in less dilution, of carbohydrates, beef-tea and clear soup, and later of eggs, custard and fish.

After the subsidence of an attack, if for any reason excision of the appendix is refused, a request is often made for a diet which shall prevent subsequent trouble. The prevalence of appendicitis in all its grades has greatly increased in the last twenty years. Severe perforative and gangrenous lesions of the appendix have shown a greater increase of frequency than the milder types, so that notwithstanding better and quicker surgery, the percentage mortality is higher or shows no fall. The cause of this increase and change of type is unknown, but it is not more mysterious than the rise of influenza in 1888 and its subsequent fluctuations and decline. There is no reason to suppose that these changes have any dependence on alterations in the national diet, and they are not confined to this country. I believe that, if a patient declines to have a diseased appendix removed, his best chance for the future lies in the prevention of constipation and the avoidance of all causes of catarrhal enteritis. Some such healthy diet as is suggested in the treatment of constipation should serve him well. Considering the possibility of checking the activity of putrefactive organisms in the cæcum by means of the acidity of the contents of the small intestine, carbo-hydrates and vegetables should be taken freely, while meat is diminished.

INTESTINAL OBSTRUCTION

In acute forms of obstruction all food should be withheld until the surgical treatment is completed. The mouth may be washed out with water acidified with lemon-juice, but little or nothing should be swallowed. The entrance of fluid into the stomach will nearly always provoke vomiting, so that nothing is gained. If it passes on into the bowel it will only serve to increase the distention.

In chronic cases, however, some food may often be given with advantage, and it should be such as will be digested and absorbed as quickly as possible. The cause of the obstruction in such cases is generally carcinoma of the colon, and both gastric and intestinal digestion are therefore impaired. Small quantities at short intervals of peptonized milk, somatose, panopepton, peptonised beef-jelly and alcohol are the most useful articles.

HÆMORRHOIDS

It must be allowed that there is little or no opportunity for the prevention of hæmorrhoids by dietetic treatment. It is doubtful whether any errors or peculiarities of diet have any relation to their occurrence; in fact their causation is curiously obscure, and the old theories of a hæmorrhoidal diathesis, of plethora, and of hepatic congestion may be discarded.

We have these anatomical facts, that the veins which undergo this dilatation are those veins which in all positions of the body, sitting, standing, or lying, are always in a dependent state, that the outgoing veins from the hæmorrhoidal plexus have no valves, and that the tissue in which they lie is subjected daily to expulsive pressure. Though these phlebectasies arise in veins which communicate both with the portal and with the general venous systems, it is clear that they are not the result of a rise in pressure in either of these systems. As regards the portal system, it is the general experience that hæmorrhoids are by no means common with cirrhosis of the liver, and as regards the general venous system it is equally certain that they do not occur in cases of backward pressure resulting from failure of the right side of the heart. It is possible that in some cases habitual excess of food and abuse of alcohol may be contributing factors, but it must be allowed that hæmorrhoids are common enough in spare energetic men leading a clean and active life. Hæmorrhoidal formation is in fact mainly a local condition due to local causes. A sedentary life, especially if this is combined with the use of soft cushions and chairs, seems without doubt to have some part in the causation. The connexion with pregnancy is undoubted. Constipation often co-exists with hæmorrhoids, and it was formerly thought to be an important cause, but even here the connexion is neither close nor constant, and in many cases it is found that the hæmorrhoids are the cause rather than the effect of the constipation.

Though hæmorrhoids do not seem to be due to any gross error of diet, it is necessary to inquire into the habits of a patient in whom a hæmorrhoidal tendency exists, and to ensure the establishment of a spare and temperate diet, perhaps with such alterations as may tend to relieve constipation. In many cases, however, there is little or no room for improvement in these respects.

When hæmorrhoids are already formed and have begun to give rise to discomfort from time to time, there is greater opportunity for dietetic treatment. Especially is this the case when inflammation has set in. The correct line of treatment is shown by the aggravation of the trouble which inevitably results from a continuance of full meals with alcohol, and such a diet should be adopted as will provoke but little gastro-intestinal hyperæmia. Meals should be small and simple, and five small meals in the day are better than three large ones. Meat should be diminished in amount, and in an acute stage may well be discarded altogether. All spices and condiments should be forbidden. No alcohol should be allowed, and except in small quantities the patient is better without tea or coffee. It is recommended by some that the amount of fluid taken should be diminished, but it is doubtful whether any advantage is so gained. The diet, therefore, should consist largely of milk slightly diluted or as blancmange or in weak tea, with butter, eggs, carbo-hydrates as toast, milk puddings, potato and honey, stewed fruit and green vegetables such as spinach and cauliflower.

DIET IN DISEASES OF THE LIVER AND PANCREAS

CHAPTER XVIII

DIET IN DISEASES OF THE LIVER AND PANCREAS

By W. Hale White, M.D., F.R.C.P.

JAUNDICE

It might naturally be thought that the exclusion of bile from the intestines would seriously modify the processes of digestion, and therefore it will be well to give a summary of the effects upon the alimentary tract of the exclusion of bile from it.

According to A. Schmidt when the bile cannot reach the intestines the amount of gastric juice is increased, and hence there is considerable hyperacidity. It is not known whether there is any change in the pancreatic secretion or the succus entericus. The view is commonly held that jaundice causes constipation, but clinical observations made with especial care teach the reverse and show that the motions may be copious and loose. This certainly is my own experience, and it is what would be expected, considering the presence of fat which would be absorbed were it not for the absence of bile. F. Müller from clinical observations, which it may be mentioned agree with those reached by experiment upon animals, concludes that the absence of bile from the intestines does not interfere with the assimilation of carbo-hydrate, protein, or inorganic matter, but the absorption of fat is greatly impaired. The stools are consequently fatty. Their amount, provided that the diet is unaltered, is three or four times the normal. The proportion of water is not altered. The specific gravity falls below 1,000, the fatty material floats on water, the reaction becomes strongly acid from the presence of free fatty acids, the needle-shaped crystals of which may be seen under the microscope and cause the greyish-white fatty stool to scintillate. By far the greater part of these crystals are the calcium salts of palmitic and stearic acids. The proportion of fatty acids or soaps to neutral fat is the same as in health namely 3–1. We learn, therefore, that one function of bile is to render fatty acids and soaps capable of absorption, and that therefore when it is absent they are not absorbed.

Bile itself has no antiseptic properties, for it does not hinder the growth of micro-organisms, indeed, as is well known, it often becomes infected in the gall-bladder, and there is no evidence that the absence of bile from the fæces leads to decomposition of them; indeed, one observer finds a remarkable diminution of bacteria in the fæces, and if the absence of bile led to an abnormal decomposition of fæces we should expect jaundice to be followed by enteritis, but this is not the case. The peculiar smell of the fæces when no bile is present is probably due to fatty acids. The wasting, often extreme, which is seen in those who have been jaundiced for some time, even when the cause of the jaundice is not malignant disease, is due chiefly to the failure to absorb fat. Lastly, it should be added that there is some evidence that bile circulating in the blood increases the protein decomposition in the body.

Clinical experience teaches us that persons who have jaundice have a great repugnance to fats, and that is what would be expected, seeing the large amount of unused fat which is present in the stools. Hence, whatever be the cause of the jaundice, the patient should take no fat. It might be thought that it would be a good thing in such cases to inject olive oil under the skin. I have injected three drachms, night and morning, of sterilized olive oil under the skin of a patient who had an intestinal fistula high up in the jejunum, so that much of his food taken by the mouth passed out unutilized, and in whom it was impossible, owing to a kink, to inject food into the lower piece of ileum. All the oil was absorbed, and the patient, by dint of feeding this way, by the mouth, and by the rectum, gained weight and strength until he reached such a condition that it was possible by resection to restore the continuity of the gut. He made a complete recovery. The oil was injected under the skin of one thigh each morning and under the skin of the other each evening. It would be worth while to try in a case of long lasting jaundice whether fat could be introduced this way, but it must be remembered that only 300 calories of food a day can be thus given, for a very bulky injection is too painful.

The wasting seen in those who are jaundiced, even when the jaundice is not due to malignant disease, is often in excess of that which can be attributed to the absence of fat from the food. There are several reasons for this. The bile in the blood leads to dyspepsia, often the cause of the jaundice gives rise to dyspepsia, and perhaps the bile in the blood leads to an excessive protein decomposition, but this is not certain.

It is clear, therefore, that the patient should take plenty of carbo-hydrates and proteins, as much indeed as his limited powers of digestion will allow, and his feeding should be little and often, especially as we have seen that he suffers from an excessive secretion of gastric juice. Many vegetables are either difficult of digestion or contain so much water that their nutritive value is low, but lentil flour, which contains 22 per cent of protein and 65 per cent of carbo-hydrate and only 1·5 per cent of fat, is a very good food for those with jaundice. Potatoes properly cooked are desirable, for they contain about 20 per cent of carbo-hydrate and very little fat. They should be steamed or cooked with their skins on, for if not they lose a considerable part of their proteins and salts. Bread, toast and biscuits are excellent, especially with jam and marmalade. If it does not cause indigestion maltine is valuable. Rice and tapioca, sago, arrowroot, grapes and bananas may all be given. Most infants' foods contain very little fat, and so they, too, may be used, and as whey and buttermilk are each of them milk from which the fat has been removed, they are useful to drink. The patient will get some protein in each of the articles of food already mentioned, but he may in addition take fish, meat, chicken and game. Inasmuch as the degree of indigestion varies much in different cases, it is difficult to lay down any exact rules, but the attempt must be made to keep up the patient's weight by foods judiciously chosen from among those just mentioned. Tea, coffee, and a moderate amount of alcohol may be taken.

GALL-STONES

If these are in the common or hepatic ducts they will almost certainly cause jaundice, and then the diet that has already been recommended for that condition will be appropriate.

As far as we know no article of diet has any influence upon the formation of gall-stones or their absorption, but it stands to reason that if the patient is eating too rich food or too much food he should be advised to take plain ordinary food. If once a gall-stone, however minute, has formed, stagnation of bile will favour its increase in size. We know that the taking of food into the stomach leads to a flow of bile, and therefore patients liable to gall-stones should not go long without meals; at least four meals a day should be taken and these at regular intervals. As few people take food during the night, the stagnation of the biliary flow is greatest at that time. On rising, therefore, breakfast should be taken early and should be abundant. It is said that, even apart from jaundice, patients suffering from gall-stones take fats with difficulty, therefore butter is sometimes forbidden; but there is no direct evidence that this is necessary.

There is no doubt that many persons who pass gall-stones, or who suffer from them, are benefited by going to Carlsbad, where the patients before breakfast drink warm water, the chief constituent of which is sodium sulphate. It is improbable that this acts on the bile, indeed how it does good is not known, but it is supposed to aid the expulsion of the stone by increasing the peristaltic movement of the bile-duct and duodenum. Be that as it may, the success attained at Carlsbad suggests that similar warm water may be taken at home. Carlsbad salts can be bought and dissolved in water. A close imitation of Carlsbad water is made by dissolving 22 grains of sodium sulphate, 12 grains of sodium bicarbonate, and 10 grains of sodium chloride in a pint of water. Twelve fluid ounces of warm Carlsbad water should be drunk before breakfast, 3 oz. each quarter of an hour. Some patients can take double this quantity, and some apparently improve by drinking an equal amount of warm water.

There is much divergence of opinion as to whether olive oil is useful in aiding the expulsion or solution of gall-stones. A gall-stone placed in olive oil at the temperature of the body slowly loses weight, because cholesterine, the chief constituent of gall-stones, is soluble in olive oil. It is the oleic acid, of which olive oil contains 72 per cent, that is the chief agent in effecting this solution, and it is suggested that when olive oil is taken by the mouth, the oleic acid is excreted by the liver or the mucous membrane of the biliary passages, and so slowly diminishes the size of the gall-stone. To some extent also the expulsion of the stone may be aided, because the intestinal peristalsis set up by the oil extends to the bile-ducts. This method of treatment is well worth a trial, for many patients say they derive considerable benefit from it. From 2–8 fluid oz. of the oil should be taken daily. The best way is to drink it after meals. Some persons do not mind doing this, but to many it is very disagreeable. The best method of flavouring the oil is to add a few grains of menthol and a little brandy to each 8 oz. of oil. Some of it may be mashed up with potatoes, salad, or fish. Pure olive oil should be used, as it is often adulterated, especially with sesame oil and cotton-seed oil, for the pure oil is expensive. If olive oil causes so much nausea that it is impossible to take it, seven grains of oleic acid—best prescribed in capsules—may be given two or three times a day. A few patients who suffer from gall-stones find they cannot take butter or the fat of meat. This is what we should expect if they are jaundiced, but if they are not it is difficult to understand why they should not take fats as easily as in health. It must be remembered that if medical treatment does not relieve the symptoms of gall-stones very considerable risk is run by leaving them. A study of a series of cases of gall-stones and a series of cases of malignant disease of the biliary passages leaves no doubt that gall-stones are a serious cause of malignant disease of the gall-bladder and biliary passages. Probably somewhere between 15 and 20 per cent of persons with gall-stones develop malignant disease of the gall-bladder or biliary passages as a result of the gall-stones. Further, about 4 per cent of all persons with gall-stones sooner or later suffer from infective cholangitis, empyæma of the gall-bladder, sloughing of the gall-bladder, or abscesses in the liver.

CONGESTION OF THE LIVER

Congestion of the liver is a term applied by the public to explain many symptoms, but we have no exact knowledge of any congestion of the liver which occurs in temperate climates except that which is associated with backward venous pressure from diseases of the heart or lungs, and the diet for these is given elsewhere. If, however, when a patient says he has congestion of the liver it appears from his history that he has been taking more food than he should, and especially too rich food, all the dietetic directions that are necessary are to give him plain simple food in small quantities at frequent intervals. He probably will not obey general directions, and hence it is a good thing to write down on paper precisely what he may have for each meal. Often these patients have many social enjoyments and dine too well when in this country, and therefore their diet cannot be effectually controlled unless they are sent to Carlsbad, Marienbad, Vichy, Ems, or some such place where strict care is taken about their diet. In these cases the stomach and intestines are probably more at fault than the liver, and the reader is referred to the article on diseases of the stomach and intestines. Patients often say they are bilious because, as a result of gastro-intestinal disturbances, they are sick and the vomit contains bile. Also, many patients who say they are bilious really suffer from migraine, although they persist that they are bilious.

TROPICAL LIVER

If a European lives for many years in the tropics he is likely to suffer from an illness in which the liver becomes enlarged. Post-mortem examinations show that this is because it is congested. Those physicians whose residence in the East makes them familiar with this disease are of opinion that the most important causes of it are exposure to great heat and errors in diet. Certainly they are supported in this view by the fact that lately the trouble has become much less frequent. Of late years the European residents in India have been taking leave from time to time, during which they have returned to England and also as a class they have been more careful in their diet, especially they have drunk less whisky. Plain simple food with very little alcohol and very little of highly spiced articles of food such as curry is important for those living in India. Failure to remember this increases the liability to hepatic congestion. During an acute attack the patient should take only milk, and in a chronic case the only dietetic directions that are necessary are that the food should be very plain and easy to digest. Unless the patient is careful about his food, improvement is impossible. Alcohol should not be taken.

Cancer of the liver.—No special diet is necessary for this condition, but the patient should take as abundantly as possible of such food as he will eat, for probably there is no disease which causes more rapid wasting, because there is the wasting due to cancer anywhere and frequently the primary seat of the cancer is in the stomach, and the indigestion produced by this contributes to the wasting. Further, if jaundice is present there is the wasting caused by the failure of the bile to reach the intestines and the consequent retardation of the absorption of fat; then, too the bile circulating in the blood causes indigestion. It has been shown that cancer anywhere in the body and especially in the stomach leads to a diminution of the hydrochloric acid in the gastric juice, and therefore it is desirable to prescribe this acid for these patients.

Cirrhosis of the liver.—Here also no special diet is necessary, but as cirrhosis of the liver is commonly accompanied by gastritis, the dietetic directions should be the same as for this condition and they are given elsewhere. It goes without saying that the patient should not take any alcohol.

Suppuration in the liver.—The diet should be the same as that given for any fever, whatever its cause. The other diseases of the liver do not require any special dietetic directions, and the only **diseases of the pancreas** that can be diagnosed are diabetes, the diet for which is given elsewhere, and cancer of the pancreas. The diet for the latter is the same as that for cancer generally, quite apart from its locality, but with this exception, that those who have disease of the pancreas cannot digest and absorb fats properly, and therefore the food should not contain much of them.

DIET IN DISEASES OF THE LUNGS

CHAPTER XIX

DIET IN DISEASES OF THE LUNGS

BY G. A. SUTHERLAND, M.D., F.R.C.P.

General considerations.—Diet in diseases of the lungs is of importance, not so much from its curative effect as from the point of view of mitigating the symptoms and relieving the discomfort of the patient. In other words, much harm may be done through a wrong or an excessive diet. The guiding principle should be to regulate the quality and the quantity of the food in such a way as to avoid throwing an increased amount of work on the lungs, which are already overtaxed. For example, if through unsuitable feeding **the intra-abdominal pressure is raised** by flatulent distension, the free action of the lungs will be impeded. Again, the **excretory action of the lungs** is interfered with in most pulmonary affections, and if by overfeeding and improper feeding the excretion of CO_2 is increased, the work of the lungs will be rendered still more difficult. The **circulation of the blood through the lungs** must also be considered. In pulmonary disease this is always interfered with, more or less obstruction being present. As healthy blood flows more easily than unhealthy, it is clear that if the blood is loaded with an excessive amount of food products and if it is increased in amount, the circulation through the lungs will be still further impeded. These conditions of the blood must be avoided if possible, for they tend also to bring on the chief danger in all pulmonary affections, namely, cardiac debility and exhaustion. For these reasons the regulation of the feeding—the amount of the food at each meal, the regularity of the meals, and the food materials—is of great importance in all acute pulmonary affections. In chronic affections, where a state of equilibrium has been established between the lungs and the other systems, the diet does not as a rule prove such a disturbing factor. In many of the chronic conditions more direct benefit can be produced through the diet than in the acute diseases.

The chief disease of the lungs, namely, pulmonary tuberculosis, has been fully considered in another section (*vide* TUBERCULOSIS) and will not be referred to here.

ASTHMA

Asthma is a chronic disease with acute exacerbations. The **nervous idiosyncrasy** which is present in the subjects of this affection is usually accompanied by certain **idiosyncrasies as regards diet.** An attack may be precipitated by some article of food, not in itself indigestible to ordinary people, such as an egg, oatmeal, etc., or by some of those foods which more frequently induce gastric disturbance, such as pork or lobster. These peculiarities are common to asthmatic patients as a class, but the special peculiarity varies with the individual. In some of these cases the food may really act as a poison, and its toxic effects are manifested by an attack of asthma after absorption into the system. In other cases, however, the effect is produced so quickly, while the patient is still at the meal, that there appears to be some stomach reflex set up by a certain article of diet, which precipitates an attack. One cannot say beforehand what special article of food will induce asthma in an ordinary case, but when the sufferer has discovered this for himself, it is clearly indicated that he should avoid this food in the future.

Asthma is a disease which can be very greatly ameliorated but cannot be cured by diet. The asthmatic subject must be taught to regard his digestion, and the selection of suitable food, as of the first importance. The pleasures of the table are not for him. The treatment of a case will commence with the ordering of a diet of simple, wholesome, well-cooked food. Perhaps it is better to say what he should not take rather than what is to be allowed. In the forbidden list will be placed rich sauces, pastry, sweetened puddings, cooked butter, cheese, nuts, dried fruits, pickles, salmon, pork, sausages, and all re-cooked meats and made-up dishes, because of their liability to cause digestive disturbance. To this list will be added the stronger wines, such as port, sherry, and Burgundy, except in strictly limited amounts. There will also be included any article of food which tends to induce an attack, as observed by the patient himself. The aid of the sufferer must be obtained in watching the effect of this simple diet and noting any bad effects from special food materials. For it is only by close observation of each individual case that any correct conclusions can be drawn as to the effect of treatment. In some there will be found a difficulty with the digestion of proteins (meat more especially), in others with the carbo-hydrates (bread and puddings), and in others with the fats. This will lead in one case to the trial of a meat-free diet, and in another to a reduction in the carbo-hydrates or fats. The conclusion, however, must not be drawn that because one patient has definitely improved on a vegetarian diet that therein lies the chief hope for all sufferers from asthma. In the majority of cases the fault will be found to lie not in the food material, but in the idiosyncrasy of the patient. Gout is the underlying cause in many cases of asthma, and for these a special regimen may be required (*vide* GOUT). At the same time one must not too readily ascribe every case of asthma to this origin, even if some of the patient's relatives or ancestors have had gout, or if the patient has been informed that he is suffering from "suppressed gout."

In addition to rendering the food suitable for the digestive powers of the patient one must also regulate the quantity at a meal, and the meal-times. A full meal will often precipitate an asthmatic attack, and if too much is taken at one time the breathing will almost invariably be affected. The patient must, therefore, be warned to avoid eating much at a time. Three moderate meals a day can be taken in many cases without disturbance, but in other cases it is advisable to order four meals a day, so as to avoid overloading the stomach. A heavy meal in the evening is especially apt to induce an asthmatic attack during some period of the night. The evening meal should be light and should be taken at least three hours before going to bed. A little fish or chicken or a cutlet, with one vegetable, and toast, followed by biscuits and butter, will supply the needed nourishment in a digestible form. The midday meal should be the most substantial one. Tea, coffee, and cocoa may be allowed to form part of the dietary, provided that they are not found to increase the difficulty of breathing.

In an acute attack the diet must be very limited and as digestible as possible. Fluids are preferably employed in the form of plain meat-soups, bread-and-milk, or milk and Benger's food. It is at this stage that a demand for stimulants is usually made by the patient, as he has experienced relief from whisky or brandy already supplied by the home authorities. There is no doubt that **alcoholic drinks** relieve an asthmatic attack, but this fact only makes their use the more dangerous. This is not the case of an attack of passing illness, but of a disease which tends to return, often with increased frequency. If alcoholic stimulation is prescribed, the tendency will be for the patient to resort to it whenever his breathing becomes troublesome. In but too many cases one finds that large amounts of alcohol are consumed by the sufferer from asthma, and that in time he becomes a confirmed tippler, on the ground that he cannot get on without regular alcoholic stimulation. For these reasons, and considering the responsibility of the medical adviser, it is probably wiser not to order alcohol in any form for the relief of asthma. Other means, unattended by the same risks, can be employed, such as strong tea or coffee, and various drugs. In chronic cases it is not necessary to forbid the lighter alcoholic beverages, such as beer, Hock, or claret, provided the patient has been in the habit of taking them in moderation and without harm to his digestion. It is never wise to order them, or to approve of their being taken, to the extent of marked stimulation.

BRONCHITIS

I. **Acute bronchitis.**—An attack of acute bronchitis is to be treated as regards the diet on the same lines as any other febrile illness. The foods ordered will be milk, soups, egg in milk or coffee, fluid puddings, and milk with small amounts of Benger's, Mellin's, or Savory and Moore's food. The food must be so regulated as to prevent fermentation and flatulent distension in the stomach and bowels. This condition will often follow from a mistaken idea of feeding up the patient. A low diet will be much more beneficial. Milk should be given with lime-water, or mixed with some solid, so as not to form large curds in the stomach. Whey is a form of milk which is specially indicated if there is a tendency to flatulence. Milk foods should be taken slowly, with a spoon, and in small quantities, 4–5 oz. at a time. Drinks of milk should not be given when the patient is thirsty. All soups should be weak, for if concentrated they tend to cause indigestion and overloading of the blood. Regular hours of feeding should be adhered to, every two or three hours according to the severity of the case and the quantity taken at a time.

In the dry stage of pulmonary catarrh, when coughing is persistent and the expectoration thick and scanty, much relief is afforded by the drinking of hot fluids freely and apart from meal times. Hot lemonade (not too much sweetened), linseed tea, weak tea, or hot barley-water may be given freely.

Lemonade may be prepared as follows. Peel a lemon very thin and put the rind into a jug ; add the juice of the lemon, 1 oz. (about five lumps) of sugar, and a pint of boiling water. Stand until it is cold and then strain. Instead of plain boiling water, barley-water (made thin) can be used, and if a little additional nourishment is wanted, the white of an egg well beaten up may be added,

Linseed tea may be prepared as follows. Put 1 oz. of linseed ½ oz. of liquorice and half a lemon into a jug, and pour over them a quart of boiling water. Let this infuse by the fire for two or three hours, and sweeten with castor sugar or sugar candy. Then stir, strain, and heat the infusion before serving.

On the other hand, when the expectoration is free and loose the intake of fluid should be limited. Even the diet given above may be partly replaced by pounded chicken or fish, with bread crumb, and toast. Alcohol is better avoided during the acute stage of bronchitis, as it tends to increase the pulmonary catarrh, but it may be called for by the supervention of cardiac weakness.

II. **Chronic bronchitis.**—While the treatment of bronchitis during an acute attack will always proceed on the same lines, there are various modifications of the diet called for in the convalescent stage and in chronic cases owing to the different factors which may induce and maintain the disease. Treatment may have to be directed to some other underlying affection, such as cardiac disease, renal disease, or gout, and the diet will have to be ordered according to the indications thus afforded. In these secondary forms of bronchitis it will be found best to leave the pulmonary condition out of consideration and to treat the primary disease.

A common type of chronic bronchitis is that induced and maintained by an excessive amount of alcoholic stimulation. This is seen not only in drunkards, but in many individuals who are never intoxicated, but who habitually take more alcohol than is good for them. It is not necessarily a question of absolute excess, but of excess relative to the powers of the patient to deal with alcohol. The excretion of alcohol through the lungs leads to pulmonary catarrh, bronchial secretion and coughing. In some individuals this will be produced by a smaller, and in others by a larger amount of alcohol. Many people take alcoholic stimulants as they take bread, without noticing the amount taken. Careful inquiry should be made in a case of chronic bronchitis as to the amount of alcohol taken, and if this is beyond the physiological allowance, it must be reduced. In other cases it will be found that alcohol has been taken because the patient has chronic bronchitis, and because of the temporary relief afforded by the stimulation. This, however, is only adding fuel to the fire. Alcohol should never be regarded as part of the treatment of chronic bronchitis, and under medical supervision only some light beer at meals, or wine well diluted, should be allowed.

Another type of chronic bronchitis frequently met with will have a history somewhat as follows. After passing the age of forty the patient noticed a tendency to put on flesh, and this had been progressive. With the increasing stoutness it was observed that an ordinary cold, which formerly did not pass beyond the naso-pharynx, had a tendency to affect the bronchial tubes. There was also an increasing frequency about these colds. Later, the ascent of a slight incline produced a shortness of breath to which the patient had been unaccustomed. Then, even on a level road, the rate of walking gradually became slower and slower, and the amount of daily exercise became considerably diminished.

There was also noticed a slight or marked wheeze about the chest, along with shortness of breath on any exertion, even when talking, and at night a desire to have the chest propped up in order to secure easy and quiet breathing. Perhaps no more acute symptoms had developed, or it may be that a run to catch a train had produced an attack of acute and alarming dyspnœa. On examining a patient with such a history we shall often find signs of chronic bronchitis and emphysema. The heart may be difficult to define owing to the thickness of the fat in the chest wall, but there are no evidences of cardiac degeneration or of valvular disease. The pulse is regular and good when the patient is at rest, and the arteries and kidneys appear to be healthy.

The patient will admit that his weight has increased two, four, or more stones above his normal. There is a direct relation between the **increase of the fatty tissue and the bronchitis.** With the development of fat, the peripheral resistance to the flow of blood has been much increased. The difficulty in the circulation is not in the arteries or in the arterioles but in the capillaries, which are increased generally in number, and are everywhere surrounded by soft resistant fat. The pressure exerted by the dense masses of fat on the capillaries hampers very much the flow of blood through these vessels. The result is that the venous pressure is lowered, the propulsive power of the heart being dissipated in driving the blood through the capillaries, and the blood returns to the right side of the heart with difficulty. The venous stasis thus induced affects also the pulmonary circulation, and a catarrhal condition of the lungs is readily set up. The heart is clogged with deposits of fat in its walls, and can but imperfectly carry on its work. The oxidation of the tissues is not complete, and the blood contains an excessive amount of carbonic acid, which throws extra work upon the lungs. These factors will all tend directly to the production of bronchitis.

As regards the treatment of such cases we shall only consider the dietetic part. The first and essential thing is to remove the excess of adipose tissue, and to relieve the lungs of the work of carbo-hydrate excretion which has been beyond their powers. It may be taken for granted, without making any objectionable inquiries, that too much food is being taken, and that the excess has been in the form of carbo-hydrates and fats. They must be mercilessly cut down, and a diet consisting largely of protein material must be substituted. Three meals a day may be ordered, to be selected from the following: beef or mutton plainly cooked, chops, steak, fish, game, fowl, kidneys, tongue and veal. These are to form the main part of the dietary, and must be partaken of in moderation, so as to avoid the evils of an excessive amount of nitrogenous food. If signs of indigestion or gastric discomfort appear, the patient has probably been taking too much. In addition to the above, there may be allowed at each meal two small pieces of dry toast, or two breakfast biscuits, or two tablespoonfuls of dinner biscuits; at one meal a tablespoonful of spinach or other green vegetable, and at another meal a raw apple. One cup of tea or coffee, or one claret glassful of water (with $\frac{1}{2}$ oz. of brandy or whisky if desired) represents the amount of fluid allowed with meals. This may be called the rigid dietary, which is modified according to the progress of the patient. While the amount of fluid taken at meals is strictly limited, the patient may be encouraged to drink at other times from 1–2 pints or more daily. Plain water is as good as any other, but soda or potash water may be taken if preferred, and Contrexeville water will be found useful if the urine contains much uratic deposit. The excretory organs will carry off the superfluous tissues more rapidly if supplied with plenty of plain fluid.

As a result of this treatment the patient should lose in weight from 2–3 lb. per week. He will also in a short time report the disappearance of the chronic wheeze, and of the shortness of breath on exertion, and an increased power of walking up an incline. He or his friends may become anxious as to the effects of this diet on his gout, for many of these patients are gouty, or are believed to be so. As a matter of clinical experience it will be found that "gouty bronchitis" in a fat subject usually turns out to be fatty bronchitis in a gouty subject. The diet, however, is both digestible and nourishing, and will not affect a gouty tendency unless indulged in immoderately. More urgent will be the patient's cry for his wine, the champagne or port which had been ordered him as "strengthening." He may be assured that his diet is a sufficiently strengthening and stimulating one, and that alcohol will only increase the tendency to pulmonary catarrh. The severe protein regimen does not require to be continued for the rest of the patient's life. When he has been sufficiently reduced in bulk, as shown by the amelioration of the symptoms, a gradual return may be made to an ordinary diet. What must be insisted on is that his meals in future should be moderate in amount, and that the carbo-hydrate element especially should not be in excess.

The addition of some animal fat to the diet in the form of milk, cream, butter, etc., is useful in all forms of chronic bronchitis, provided that the digestion is not overtaxed. The patient who has bronchitis every winter will probably benefit more from cod-liver oil taken throughout the cold months than from any other therapeutic measure.

In the **chronic bronchitis of elderly people,** which may be described as that due to cardiac weakness and respiratory difficulty, a more stimulating form of treatment may be called for. The employment of small and frequent meals of nourishing food will be found beneficial generally, and will not cause indigestion and flatulence. Alcohol may be used more freely in this form than we have felt justified in recommending at the earlier periods of life. The cardiac and respiratory centres will benefit from the stimulation which alcohol supplies. Two to three ounces of brandy, or a couple of glasses of port or Burgundy may be taken daily.

In infancy bronchitis is for the most part associated with rickets, and is often of a most acute kind. In the acute stage the diet is that of a feverish attack, but afterwards much may be effected by diet both in the prevention of further acute attacks and in the cure of chronic bronchitis. Rickets is a disease which leads directly to a catarrhal condition of the bronchial tubes. The tendency is still further increased by the fact that the preceding diet has usually been one containing an excessive amount of carbo-hydrate material. An excessive carbo-hydrate diet throws extra work on the pulmonary powers of excretion, and produces an excessive amount of flabby adipose tissue which interferes with the circulation through the lungs. These conditions must be altered by the adoption of a full anti-rachitic diet (*see* RICKETS).

The leading measures are to reduce the carbo-hydrate intake, and to increase the amount of animal fat and proteins.

LOBAR PNEUMONIA

It is now generally recognized that **lobar pneumonia** is a fever, with local manifestations in the lungs, and complicated in many cases with inflammation in other tissues. The diet during the attack, therefore, will be on the same line as that of fevers generally. It is important to remember that the duration of the disease is usually limited to from 7–10 days, and that cardiac failure is the most common cause of death in fatal cases.

The food materials to be used are milk, or preferably whey, beef, mutton, or chicken-soup, and coffee or tea with an egg in it. As a rule thirst is marked, appetite is lost, and digestion is very much impaired owing to the high temperature and the toxæmia present. One and a half pints of whey or milk, one pint of soup and one egg daily will represent a sufficiently full dietary. The milk may be rendered more palatable and digestible by the addition of lime-water, barley-water, or Apollinaris water. It may also be thickened by the addition of Benger's food, or boiled bread or rusk, which renders it more digestible for many patients. Farinaceous preparations and sugar must be given in small amount owing to the tendency they have to induce indigestion and flatulence. Sugar of milk may be given (from ½–1 oz. daily), as it is nourishing, digestible, and not so apt to induce flatulence as other forms of sugar. The soups should not be concentrated, and should be made from fresh meat or fowl rather than any preserved essence or jelly. The latter substances serve a function in forming a change for the patient, and being easily taken when the appetite flags, but they have not the nutritive value of the freshly made preparations, and many of them have no nutritive value at all. It is sometimes pathetic to see the implicit confidence of the patient's friends in some bottle or tin of meat essence, while they despise such foods as milk and eggs.

The meals should be small in amount, and given frequently, every 2 or 3 hours during the day, and every 4 hours during the night. The danger is not from underfeeding but from overfeeding. Nature has taken away the appetite because the digestive organs are weakened. As the fever is a short one, no harm will follow from allowing only a small amount of food, and the patient will be much more comfortable. Instead of increasing the patient's natural powers of resistance to the disease, which, after all, will prove his chief safeguard, we are only weakening them by pouring into the system more food than he can properly assimilate. In the full-blooded **healthy pneumonic subject** one can do more good by what is practically a starvation diet than by giving the most nutritive foods in excess. In **debilitated subjects** and in **elderly people** the low state of vitality is an indication for the employment of as much nourishing food as the patient can take. More concentrated soup, egg and milk, raw meat-juice, and even cream may be given, but the digestion must be carefully watched and must not be overtaxed. Above all things, flatulent distension of the stomach and bowels must be avoided, as the effect on the heart and lungs from upward pressure may prove most prejudicial to the patient's chances of recovery. If gastric disturbance is present, the food should be peptonized and given in small amounts frequently, 2–3 oz. every hour during the day.

Thirst may be relieved by **drinking freely of water**, lemonade, barley-water, etc. These may be given cold, but should not be iced unless they are taken in sips, so as to avoid chilling the stomach. The action of the skin will be aided by the plentiful use of fluids, hot or cold, and in addition the elimination of the poison in the blood will be largely helped by free diuresis. If water is not taken freely by the mouth, and if the secretions are scanty, hot saline injections by the rectum, or subcutaneously, should be employed. Elimination of the poison is most desirable, and this can best be effected by the passage of plenty of water through the system. A careful distinction should be made between the fluids which are given as food and those which are given as drinks. The times of feeding are to be rigidly adhered to, and the drinks given between meals should not have any milk or soup added, or anything which will call for digestion.

During the first four or five days of the illness feeding on the above lines can usually be carried out satisfactorily, but in the **pre-**

critical stage some extra precautions are called for. Exhaustion may now be showing itself, delirium or semi-consciousness may be present, the appetite may be lost entirely, and a condition of general toxæmia may be present. What the friends notice is the increasing weakness, and what they demand is more food for the patient. This natural desire on their part must be strongly combated. For the time being the patient's power of digestion has gone, and even if predigested food were given, his powers of assimilation are in abeyance. The stimulation which he requires at this time cannot, therefore, be given by food, or only to a very slight extent. The period on which he is entering is not a long one, and a plentiful supply of water, with very small quantities of milk, beef-juice, or white of egg, is all that is really called for. During the pre-critical stage and at the crisis the question of food may be left out of consideration, and attention directed to the temporary stimulation of the patient by means of alcohol, etc. **After the crisis** has passed more food can be taken and should be given, but the food materials should be the same as during the fever for a few days at least. Returning appetite will soon indicate the return of digestive powers, and more solid food may be given. Within a week the patient is usually able to take fish, fowl, and meat.

ALCOHOL IN THE TREATMENT OF PNEUMONIA

Amidst the uncertainties that still surround the subject of pneumonia one fact seems to be generally accepted, namely, that the chief danger is death from cardiac failure. In considering the question of the **value of alcohol** in this disease one is met at the outset by two difficulties, first, that there is no agreement as to the cause of the cardiac failure, which is the reason for giving alcohol, and secondly, that there is no agreement as to the action of alcohol on the circulatory and nervous systems. For instance, it has been held by different writers that the cardiac failure is due to some form of inflammation of the heart, to obstruction of the pulmonary circulation, to poisoning of the medullary centre, and to the general toxæmia.

Now if alcohol in any form and in any amount is a poison to the system, as some maintain, and if the patient is already suffering from a toxæmia which is depressing the heart, it is plain that the combination of two poisons will not prove beneficial, unless one is the direct antidote of the other. Such a view is not commonly held, but Dr. A. H. Smith, writing in the *Twentieth Century Practice of Medicine* on the excessive amount of alcohol which may be given in pneumonia without producing toxic effects says: "It seems scarcely possible that the benefit in these cases comes from the stimulant effect alone. It is more likely that the alcohol acts directly upon the microbe by mingling with the medium in which it grows, or that it has an antidotal effect upon the poison already in the circulation." This suggestion appears to be altogether too speculative to call for further notice.

It may be urged that plenty of time and opportunity has now been afforded to settle the question as to the use of alcohol in pneumonia, but the question is not so simple as it appears.

It is not a case of treating pneumonia, it is a case of treating a patient suffering from pneumonia, and patients vary in their susceptibility to alcohol just as they do to other drugs. One class of patient may respond well to alcohol as a stimulant, in another it may act as a depressant, in a third it may provoke gastro-intestinal disturbance, and so on. Each observer will tend to be influenced in his judgment by the results which occur most frequently under his own observation, and as the experiences of various observers may differ very considerably, their conclusions may appear to be diametrically opposed. Again, the cardiac weakness may be due in one case to pre-existing heart disease, in another to pneumococcal carditis, in another to pulmonary obstruction, and so on. These are complications and not the ordinary conditions of pneumonia, which we are now discussing.

Regarding the use of alcohol in the treatment of pneumonia we are not justified in laying down any dogmatic rules which will apply in all cases. We must, however, have certain views as to the nature of the cardiac failure, and as to the action of alcohol, if our treatment is to be anything but empirical. For the sake of clearness two assumptions will be made in the following remarks, first, that the commonest cause of cardiac failure in pneumonia is poisoning and paralysis of the medullary centre, and secondly, that alcohol is in the majority of cases a stimulant of that centre. These are assumptions, and space will not allow of my going fully into the reasons for adopting them, but the following points may be briefly alluded to.

As regards the first it may be pointed out that pneumonia differs from most other acute fevers in the tendency to fatal cardiac failure within a brief period. Even in the case of rheumatic fever, which is the disease in which the heart tends to be affected early and in an indisputable form, we find no such liability to rapid failure. As a rule no post-mortem changes are found in the heart in pneumonia other than those common to pyrexial and toxic conditions. A condition of pericarditis, endocarditis, or myocarditis, of pneumococcal origin, must be regarded as exceptional, and as previously stated rather as a complication. The pyrexia is not in itself a sufficient cause, for in other affections pyrexia of equal degree does not rapidly induce fatal cardiac failure. The embarrassment of the pulmonary circulation is not sufficient to produce the conditions seen in pneumonia. Dilatation of the right heart may occur, but it is by no means the characteristic feature of cardiac failure in this disease. There is no apparent obstruction in the circulation which would account for death in most cases. Both on clinical and post-mortem evidence we are unable to trace the fatal result to the heart or to the circulation.

When we turn to the nervous system we find evidence early in the disease that the medullary centres are affected. The rapid breathing so characteristic of the disease is not a sign of pulmonary embarrassment, but of stimulation of the respiratory centre. It is rapid, involuntary, unconscious, and diaphragmatic. There are no signs of pulmonary distress. The cardiac action also would seem to indicate stimulation of the medullary centre. It is slow in proportion to the pyrexia and the rapidity of breathing, a condition which appears to be the result of the inhibitory action of the vagus under stimulation. These are the changes seen in the early days of the disease when stimulation of the cardio-respiratory centres in the medulla by toxins is present. The pulse may be full and bounding. The later stages of an attack show a different picture. The breathing may still be rapid, but becomes laboured, conscious, voluntary, and costal, with all the accessory muscles of respiration brought into play. The check action is removed from the heart, and the pulse runs up to 120, 140, 160, or more, with marked weakening of the cardiac action. These signs point to increased poisoning of the cardio-respiratory centres in the medulla, to gradual failure, and to complete paralysis in one or both when a fatal result follows. Why the cardiac failure should precede respiratory failure appears to be due to the fact that a patient possesses accessory muscles and methods of respiration, while he has no such means of aiding the circulation.

The second assumption, that alcohol is in the majority of cases a stimulant to the medullary centres, is one based on the clinical experience of many observers.

In any given case of pneumonia we must take into consideration (1) the proper time for giving alcohol, (2) the indications for its use, (3) the contra-indications, (4) the form and dosage, and (5) the conditions of the patient, apart from the pneumonia, which may affect the treatment.

(1) **The proper time for giving alcohol.**—At the beginning of an ordinary attack of pneumonia in a previously healthy, or moderately healthy subject, there is no occasion to give alcohol. Some commence the routine treatment of pneumonia with 3 or 4 oz. of brandy a day, and assert that cardiac debility must be averted by early treatment with alcohol. A special characteristic of alcohol is that it acts quickly, so that one has not to wait a few days for its effects to be perceptible, as in the case of digitalis. In the early days of a pneumonic attack alcohol should be withheld, and the patient's strength should be sustained by suitable food. After the fourth day, or when the signs of the pre-critical stage present themselves, alcohol may with advantage be given and continued through the exhausting period of the crisis, until recuperation has set in. The period during which alcohol may be beneficially given will thus be limited in ordinary cases to from three to six days.

Its action is strictly comparable to that of the other stimulants which may be used at the same time. After the crisis has passed, the amount of alcohol may, as a rule, be rapidly diminished.

(2) The first **indication for the use of alcohol** is given by the pulse. When the pulse becomes small or irregular or compressible, and runs up to 110 or more per minute, alcohol is called for. The more suddenly this change takes place, the more urgent is the call for alcohol, as the whole system is injuriously affected by a sudden impairment of the circulation. Confirmatory evidence will be found on examining the heart, when the first sound at the apex may be found to be weakened or blurred, and some dilatation of the left ventricle is present. Unless some evidence of cardiac weakness is recognized it is not advisable to give alcohol. Other associated disturbances of the system may indicate a case for stimulation, for instance sleeplessness. This can often be relieved by a full dose of alcohol. Again, the cardiac weakness may induce a disturbed state of the secretions, as shown by a dry mouth and tongue. Here also alcohol may afford relief. There may be low muttering delirium, with restlessness, owing to the weakened circulation through the brain, a condition which is often benefited by alcohol.

Having decided to use alcohol for one or other of the above indications, one must give it a fair trial and watch the result closely. The stimulant is not to be continued on any general principles, but on the indications which the progress of the patient affords as to whether it is acting beneficially or not. If the pulse is slowed and the cardiac action improves, if the secretions become re-established, and if the delirium or restlessness or sleeplessness is removed, then the alcohol is probably doing good and is to be continued as required. If, on the other hand, one fails to perceive any improvement under the use of alcohol in sufficient amount, it is better to discontinue it and trust to other forms of stimulation. It should be kept in mind that many cases of pneumonia can be successfully treated without alcohol at all, and that the indications for its use should be as clear as in the case of any other powerful drug.

(3) There are **certain contra-indications** which must be referred to. In the presence of a full and bounding pulse it

is folly to give alcohol as a cardiac stimulant, or for any symptom such as restlessness or sleeplessness, or delirium, or loss of appetite. If there is reason to suppose that pneumococcal myocarditis or endocarditis or pericarditis is the cause of the cardiac weakness, alcohol will not be called for in large doses, and it is questionable whether under these conditions stimulation by alcohol will benefit the heart. My own experience has been that in acute inflammation of the heart the less alcohol one gives the better. If there is considerable blockage of the pulmonary circulation, and embarrassment of the right side of the heart, these conditions should be relieved by other measures, cupping, leeching, etc., before alcohol is used. The place of alcohol is to strengthen the action of the left ventricle after the state of the pulmonary circulation has been relieved. If there is much pulmonary œdema or bronchial catarrh, the free use of alcohol will rather tend to aggravate the condition unless it is traceable to weak action of the left ventricle. If the patient is prostrated by profound toxæmia, any attempt to revive him by large doses of alcohol will probably prove useless. His blood and tissues, already saturated with the poison of pneumonia, will neither be purified by means of alcohol, nor rendered more capable of throwing off the toxins. As already stated, it is the collapse produced by failure of the cardiac centre, and not that caused by general toxic infection, which will be benefited by alcohol. If the effect of alcohol is to excite and disturb the patient, to increase the distress, or to fail in producing an improvement in the cardiac embarrassment, it is advisable to reduce the amount or to discontinue it altogether.

(4) The **form in which the alcohol is supplied** is important. Some have advised the use of the stronger wines, port and sherry, because of the special ethers they contain, and of the added nutritive effect as compared with a plain spirit such as brandy. The ethers can hardly be determined beforehand by the doctor, and the chief point to be considered is the stimulating effect of alcohol. In the case of wines the strength in alcohol varies so much that one cannot regulate accurately the amount of alcohol which is to be given. A sound brandy or whisky is to be preferred as allowing of exact alcoholic dosage, and as supplying

the stimulant in a form which is suited to most stomachs. If the patient or his doctor has a preference for rum or gin, equally good results may be obtained from either of these. On the grounds of palatability and quickness of effect champagne has also distinct claims, and it may sometimes act better than brandy in disturbed states of the stomach. After the crisis has passed and the stage of convalescence has been entered on, port or sherry or Burgundy may be employed in place of the spirit.

The **question of dosage** is one to be determined by the special requirements of the case. Speaking generally, one may say that a mild amount of stimulation will be secured by 3 oz. of brandy or whisky in the day, a moderate amount by 6 oz., and a full amount by 9 oz. If it be said that these would be large amounts for a person in perfect health it may be replied that the conditions in pneumonia are quite different. It is well known that many patients suffering from pneumonia can take large quantities of alcohol without the production of those symptoms which would certainly follow from the same amount taken in a condition of good health. The object of the stimulation is to raise the force of the circulation as nearly as possible to that existing in health, and the dosage is to be regulated on this principle. Again, it may be said that the effect of large doses of alcohol on the tissues generally has been found to be injurious. To this it may be replied that such an effect depends upon the length of time during which the absorption of alcohol has been going on. The question of alcohol in pneumonia differs from that in most other affections in that it is a self limited disease, and in that the period of stimulation may be put down as from three to six days. It is a case of treatment during a critical period, and we are justified in pushing our remedies in a way which would not be possible or advisable in a case of prolonged illness. From this point of view the above-mentioned amounts are not excessive, and if the stimulating effect is beneficial, no permanent harm can be done to the system by the alcohol. These amounts will not, in the vast majority of cases, require to be exceeded. At the same time, if the physician is convinced that the alcohol is benefiting the patient, and that more is called for, he should have the courage of his convictions and increase the quantity.

It is advisable to give the brandy or whisky in doses of from 2–4 drachms, at regular intervals, and diluted with at least twice the amount of water. The aim is to produce a steady and continuous stimulative effect. Larger doses tend to upset the digestion and to produce a temporary over-stimulation followed by a reaction. Sometimes, however, a condition such as sleeplessness or delirium may be best treated by one full dose of from 1–2 oz.

(5) Certain **personal factors** in the patient modify the treatment by alcohol. **Age** is one of these. In the majority of cases of lobar pneumonia in infancy and childhood alcohol is not called for. In certain cases the threatening of cardiac failure, at or about the crisis, may be best met by alcohol. As a rule from half to one ounce of brandy in the twenty-four hours will be sufficient. **In elderly people** the pneumonic poison tends to affect the cardiac action at an early stage so that alcohol is called for early. There is more general agreement about the benefit derived from alcohol in the pneumonia of advanced life than at any other age. While alcohol is called for early, it is seldom required in such full doses as at the more robust period of middle life. The reserve powers of the nervous centres and of the heart are weakened by age, so that they cannot respond to stimulation to the same extent as in earlier years, and the full amount of stimulation possible is produced by smaller doses.

The **chronic alcoholic patient** is a bad subject for pneumonia, but he must be treated with alcohol freely. To discontinue the alcohol by which his nervous system has been sustained, and to allow the poison of pneumonia to take its place, is not a wise policy. He cannot be fed up during acute illness, and the omission of his accustomed stimulant will probably precipitate a fatal termination. It is not much use ordering 3 oz. of whisky in the twenty-four hours to a person who has been in the habit of taking a pint or more daily, so that the amount of stimulant which is required will depend largely on the quantity which the patient has been in the habit of taking. It is not necessarily as much, but it will probably be considerably in excess of that which would be considered sufficient for a previously abstemious subject.

PLEURISY

In an attack of acute pleurisy the ordinary diet for a febrile illness is to be employed. When effusion takes place, either as the result of an acute attack or in a chronic form, more special treatment as regards the diet has sometimes been carried out. Attempts have been made by means of a dry diet, i.e. with the fluid elements reduced to a minimum, to check further effusion, and to procure absorption of the fluid. As a rule this process is an extremely irksome one to the patient. The therapeutic results do not seem to justify this mode of treatment. In the case of pleurisy one is dealing with an active inflammatory process, and an excess of secretion goes on in spite of a limited fluid intake. In cases of chronic effusion, after the subsidence of active inflammation, the fluid can be removed much more quickly by other measures, and with much less discomfort to the patient than by deprivation of fluids and fluid food. On the other hand it is not advisable to encourage a large fluid intake on the part of the patient during the stage of effusion, but rather one will try to keep the amount of fluid given in strict moderation. Again, the employment of a salt-free diet, however useful it may be in certain cases of renal œdema, is not to be regarded as a remedial measure in pleural effusion. Diuretic drinks are, as a rule, of no effect. With reference to the diet, the only clear indications are to maintain the patient's strength by as full a diet as the state of the temperature and digestion will allow of.

The other diseases of the lungs do not call for any detailed notice. **Broncho-pneumonia** or **catarrhal pneumonia** is to be treated as a fever of varying length and with the same precautions as lobar pneumonia. That is to say, the diet must be regulated so far as possible with a view to leave the pulmonary action unimpeded. In the case of infants it may be regarded as a specific fever, or as a complication of specific infection, and the diet should be regulated accordingly (*see* Chapter X).

Hay fever is an acute febrile disorder, which does not as a rule call for any special dietetic treatment, except in that form which is associated with asthma. In the latter case the precautions and limitations already described ought to be fully carried out (*see* ASTHMA).

Emphysema is not very amenable to direct treatment by means of diet, but the comfort of the patient will be maintained by a regimen similar to that described in connexion with Chronic Bronchitis (q.v.).

DIET IN DISEASES AND DISORDERS OF THE HEART

CHAPTER XX

DIET IN DISEASES AND DISORDERS OF THE HEART

By W. J. Hadley, M.D., F.R.C.P.

It is well to remember that the dietetic treatment of heart troubles includes prevention as well as alleviation; the treatment of functional disorders as well as those attended by actual disease of the organ. In many of the functional disorders, the consideration of the diet, and the treatment directed to the digestion, are all that is needed for the relief of the symptoms; whilst, when the heart is actually diseased, the back-pressure congestion in the stomach, liver, and digestive organs generally, constantly makes digestive disturbance the first symptom for which the patient comes to seek relief.

FUNCTIONAL DISORDERS

Functional disorders present such symptoms as pain, cardiac distress and pseudo-angina, rapidity, palpitation and irregular or intermittent action of the heart.

We will consider the treatment of such functional disorders under the following headings:—

1. Functional troubles due to dyspepsia and hepatic engorgement.

2. Functional troubles due to errors in diet or abuse of food, drink or drugs.

3. Functional troubles due to nervous disorders—functional or organic.

4. Functional disorders due to anæmia and debility.

5. Functional troubles due to febrile conditions and toxæmia.

N.B.—It will be noticed in the above list how frequently the trouble is due to something that the patient is doing wrong. One cannot too strongly insist on the necessity for inquiring carefully into the life and doings of such patients. Otherwise the dyspepsia, or the heart trouble alike, will be treated unsuccessfully, the actual cause not having been discovered and removed.

1. **Dyspepsia and hepatic engorgement.**—It is well to recognize the fact that more patients come complaining of heart trouble when the digestion is at fault than do those whose hearts are actually diseased. The dietetic treatment of dyspepsia will be considered under its proper head (to which the reader is referred); but it is necessary here to draw attention to the frequency of the complaints, as to the heart, occurring in dyspeptics, and also to emphasize the necessity in all such cases for particular care being paid to the healthy condition of the mouth and teeth and even more to the removal of worry, hurry or irregularity in taking of meals, work in too close proximity to meals and so forth. It is to be noted that it is chiefly those whose dyspepsia is caused or complicated by some of the above mentioned conditions that complain loudest of their hearts, and that the heart symptoms frequently become relieved by attention to such matters long before the dyspepsia is quite gone.

2. **Errors in diet and abuses of food, drink or drugs.**

(*a*) Errors in diet are as frequent causes of heart symptoms as dyspepsia itself, and although such errors usually cause dyspepsia this is by no means always the case, and heart troubles may be caused by such errors without there being any obvious dyspepsia. It is only necessary to indicate the various ways in which patients *do* err in order to make the treatment obvious. What has been said above as to hurry, worry, irregularity, etc., should be repeated here, as they are, perhaps, the most common errors. We have also the taking of meals, or drinks, which are too large, too indigestible, too hot or too cold (iced); too much or too little fluid taken, or too great a frequency in meals. Of course, the majority of such errors cause cardiac symptoms by causing dyspepsia, but not all. A stomach which is simply acutely or chronically over-distended will cause some or other of the cardiac symptoms mentioned above: and we have seen very serious symptoms occur as the result of swallowing very hot food, and another case of syncope from taking a big iced drink; both occurring in people with perfectly healthy hearts and without a symptom of dyspepsia. In both these cases the effects were probably reflex, through the nervous system.

The treatment consists wholly in removing the cause and in regulating the diet to suit the particular case.

(*b*) ABUSE OF DRINKS AND DRUGS.—We must here consider the treatment of abuse of tea, coffee, alcohol, tobacco, morphia and other drugs.

Tea and coffee can conveniently be taken together. Nothing is commoner than to find some functional disorder resulting from abuse of one or both of these beverages, occurring either with or without dyspepsia. The symptoms are sometimes immediate or may be delayed until some hours after the ingestion. It is quite easy to forbid their use altogether, but such an order is frequently not obeyed, and although it may be necessary in some instances, it is well to try and find a middle course between abuse and abstinence. Tea, taken once a day, can sometimes be borne, when, used more frequently, it causes heart trouble. Similarly very weak tea, or China tea, can often be tolerated when stronger, or Indian, tea causes symptoms. Coffee usually causes less trouble than tea, but some people have a peculiar susceptibility to it. Much the same may be said with regard to its limited use as has been said of tea. In the case of both tea and coffee, they sometimes only cause cardiac trouble when taken alone, whilst they can be borne if taken with food. Wherever they have caused symptoms, they should be used, in future, more as flavourings than taken as beverages in the ordinary way. It is important to remember that tea frequently causes dyspepsia and heart symptoms if taken with a meat meal.

Tobacco.—Perhaps there is no more alarming condition with reference to the heart than acute or chronic nicotine poisoning. It has long been recognized that the dose likely to produce harm differs in individuals: that some are very sensitive to even small doses, while others seem practically immune to even large doses of the poison.

Some of these cases are purely functional, entirely due to the abuse of tobacco, whilst others are a combination of old morbus cordis and abuse of alcohol in addition to the nicotine poisoning; for it is not uncommon to find the abuse of tobacco one of the chief hindrances to the establishment of proper compensation in cases of true heart disease. In such cases the heart will be found with irregular and feeble action, often dilated, whilst the patient will complain of many of the symptoms of heart failure, though there is rarely œdema unless the abuse is complicating true heart disease.

Here again we have only to discontinue the use of tobacco to get rid of the symptoms altogether if they are entirely due to tobacco, and to get a marked improvement if the condition is one in which tobacco plays a part only. In most of the cases dyspepsia has also resulted from the abuse, and care will be needed in the management of the diet, with treatment, as well as abstinence from the tobacco.

Alcohol.—Abuse of alcohol is a most frequent cause of heart trouble, with or without its usual attendant, dyspepsia. Palpitation, faintness, pain over the precordium, shortness of breath are frequently complained of. Sometimes the patient describes sudden attacks of oppression and distress of breathing, waking him in the night, very much resembling cardiac asthma or even angina pectoris; whilst in the morning he is sick and faint and the pulse is often small, weak and occasionally irregular and rapid. In cases of long standing abuse, myocardial degeneration results with dilatation and cardiac failure with all the signs and symptoms pertaining thereto. There are few cases which are so difficult and unsatisfactory to treat. In many of them the digestion is ruined, the liver diseased and the general health undermined. The question between total abstinence and moderation will have to be considered, but in the majority of such cases nothing short of total abstinence will be of any permanent good. It is not always possible to attain this at once, but it is the goal to be aimed at. There is usually loss of appetite, occasionally sickness and a loathing of food, and one of the great difficulties is gradually to substitute food for the alcohol as it is diminished.

In the worst cases it is far the best course to put them to bed under skilled nursing, because, first, they are often so weak and feeble that they are unable to digest even small quantities of nourishment while up and about and, second, it is the only way of insuring that alcohol is diminished or abstained from as desired. In such cases it will frequently be found that milk, soups, broths or meat extracts are the only forms of nourishment that can be borne, and it may be necessary even to peptonize the milk for a time.

The diminution or total withdrawal of the alcohol habitually taken often necessitates the use of some cardiac stimulant in the shape of strychnine or digitalis—preferably the former—or small, and ever diminishing, quantities of alcohol may have to be returned to for a time. As the power to take food returns these stimulants can be discontinued. In these cases sleep is all important, because it soothes the mental excitement so common in such patients, but also because it gives the heart a much needed rest. It will be necessary, however, to use great care in the exhibition of hypnotics, especially morphia, because of the frequency of the presence of renal disease in such cases. It will generally be found that systematic and good feeding will insure the necessary rest, and it is here that the skilled nurse is so helpful, always being able to do so much more than relations or untrained servants. Later, when the patient has sufficiently recovered, and from the first in those who have never been so ill, exercise and open air are important in order to increase the appetite and general vitality. Finally will come the question "What am I to drink?" The abnormal craving for some "nip," or stimulant between meals has sometimes to be catered for, at any rate for some time, and if tea and coffee can be borne, they are often the best substitutes though, as we have seen, their immoderate use may be attended by cardiac symptoms; and although they constitute a lesser evil, their habitual and prolonged use is not to be advised. With meals, water, milk, barley-water, lemonade and ginger beer are the best, or a light claret, or lager beer, may be allowed in some cases. Highly spiced foods, strong sauces and an excess of meat will often be found useful stepping stones between alcoholic abuse and a more healthy appetite, and although their habitual use cannot be recommended, they may be found very useful for a time.

Morphia, chloral and other hypnotics, antipyrin, etc.—The abuse—and in some cases even the use—of these and other drugs may be attended by symptoms of cardiac failure. When the cardiac failure is acutely manifest, appropriate treatment for the poisonous effects of the drug (morphia, e.g.), with the exhibition of stimulants, will be necessary. This is not a question of dietetics; but in mentioning the cardiac symptoms frequently presented by such patients, one must emphasize, from the point of view of treatment, the great importance of food. In most of these cases the taking of proper nourishment has been neglected, and frequently the digestion is wofully deranged by the abuse of the drug. They are often wasted and feeble, and the heart symptoms complained of are often caused as much by the dyspepsia and debility present, as by the drug taken. What has been said in speaking of alcoholic abuse may be repeated here. Such cases should be put to bed under skilled nursing, and while their particular drug is gradually diminished, food should be carefully and systematically increased. The importance of skilful feeding cannot be ranked too highly.

3. Nervous disorders—functional or organic.

Under this heading we shall first consider the heart troubles of hysteria, neurasthenia, mental strain and worry, and then mention must be made of those occasionally attending true cerebro-spinal disease.

Hysteria and neurasthenia, etc.—The functional heart troubles occurring under these conditions are well known, and the complaints made by such patients as to their hearts often form a large part of their symptoms. Many of them are convinced that they have "heart disease," and most of the symptoms of organic disease and cardiac failure are faithfully presented. Thus, cardiac pain and oppression, palpitation and shortness of breath are usual complaints. In many there is undoubtedly an attendant cardiac debility, as witnessed by the almost constant great increase in rapidity, on even slight mental or physical exertion, which is so commonly a feature in neurasthenic subjects, but it is obvious that this debility is only part of a general, and not a special, cardiac debility.

In no class of cases has treatment by rest and judiciously increased feeding shown such good results as in these hysterical and neurasthenic patients. In many of them, from nervous debility, unwise management of their lives, fear of getting fat, or fear of dyspepsia, food has been neglected or improperly assimilated, and although many are not wasted, all their symptoms cry out for better nourishment. It would be out of place here to give the details of what is now known as the "Weir-Mitchell" treatment; it will be discussed fully elsewhere. It will be sufficient to say that, under such treatment, the cardiac as well as the other symptoms of the patient gradually disappear. After convalescence these cases must be advised to regulate their lives, and more especially with regard to food, for in this matter they are most likely to err; a nourishing diet and regular life must be insisted upon.

Cerebro-spinal disease.—There are but few disordered cardiac states directly connected with organic disease of the brain and spine. The bradycardia of some meningeal cases, is an instance of the connexion, as is also derangement of the heart with some affections of the pneumogastric and sympathetic nerves, but there is nothing to be said as to the dietetic treatment in such cases.

Cardiac failure is a prominent feature in some cases of injury to the skull, brain or spine. The only indication, in these cases, is the great care necessary in the use of alcohol, remembering that, although the heart may show the need for stimulation, such stimulation may do great harm to the cerebral lesion (e.g. hæmorrhage).

In locomotor ataxy we have, occasionally, heart crises, but such conditions call for no special dietetic treatment.

4. **Anæmia and debility.**—The treatment of anæmia and debility will be described elsewhere. Many of these cases complain more of their heart symptoms than of anything else. In a number of them, all that has been said regarding cases of neurasthenia might be repeated. In a great many the anæmia itself is the result of dyspepsia and improper feeding, and whether

the full "Weir-Mitchell" treatment is thought advisable or not, all of them are improved by the careful regulation of their diet and an increased amount of nourishment. As a rule, milk forms the best addition to an ordinary dietary, because of the ease with which it is generally taken and digested. In other cases it may be found that the patients are taking large quantities of starchy food and little or no protein, and it seems that to some individuals at any rate some form of meat food is essential for the formation of good blood. In other cases again the anæmia is largely, if not wholly, caused by constipation, and in such instances the regulation of the diet and the amount of fluid taken is a far better, and generally more permanently effectual, means of overcoming this trouble than habitual drug taking.

5. **Febrile states and toxæmia.**—Probably all febrile conditions are attended by a state of toxæmia, but there are other toxæmias which are afebrile.

Amongst the febrile conditions we have all the infectious troubles including pneumonia, typhoid, etc. In a vast majority of these cases death is, more or less, directly due to cardiac failure. The old adage says, "Stuff a cold and starve a fever," but we find that in many of the cases now under consideration starving is a most unwise policy. Most of us have seen cases of pneumonia, and other septicæmias which owe their recoveries entirely to their extraordinary powers of taking nourishment, whilst, on the other hand, cases are often met with in which we see the inability to take nourishment well inevitably followed by cardiac failure. The dietetic treatment of fevers, etc., will receive attention elsewhere, and we need do no more here than emphasize the importance of the use of plenty of suitable nourishment, as a preventive of cardiac failure in such cases. The dry, unwholesome state of the mouth and lips in febrile cases is often a cause of the anorexia, and careful attention to their toilet will frequently increase the amount of food taken. Another important point is the regulation of the diet so as to prevent what is so common in many cases, viz., abdominal distension. This condition is apt to occur in all febrile and toxæmic states; it is necessary, therefore, to use great care to prevent the nourishment increasing this tendency, because the pressure caused by the consequent raising of the diaphragm is a potent element in bringing about cardiac failure. The diminution or total withdrawal of aerated waters may be all that is necessary in some, whilst the peptonizing of all the milk taken may have to be resorted to in other cases. The discontinuance of all medicines by the mouth is often of importance, so as to leave the stomach undisturbed by possibly irritating drugs. All necessary medication must be carried out subcutaneously or per rectum. Great care must be used in the supervision of the milk, its storage for instance, and to see that it is alkaline when given. The addition of lime-water, bicarbonate or citrate of soda, to the milk will often help in its digestion. Sometimes the substitution of junket, or curds and whey, or whey only, with or without the addition of a little cream, is found helpful: or it may be necessary to discontinue milk altogether, giving weak meat, veal or chicken broths instead. It seems sometimes as though the copious use of fluid food is the direct cause of the abdominal distension; concentration of the milk by evaporation will, in some cases, be found effectual in removing this troublesome condition and so in relieving cardiac symptoms. The giving of solid food too soon, however, is another cause of distension, and its occurrence should warn us of the necessity for returning to fluid food for a time.

In considering the afebrile toxæmias, mention must be made of the cardiac failure attending the last stages of such diseases as hepatic cirrhosis (cholæmia ?) Bright's disease (uræmia ?), diabetes (acetonæmia ?) and Addison's disease. One must refer the reader to the articles on these diseases for their treatment. The cardiac failure, in all of them, is more manifest towards the close of the case, when dietetic treatment can be of but little avail.

Exophthalmic goitre.—This seems the best place to consider the treatment of the heart trouble occurring with exophthalmic goitre. It is a noticeable feature in this disease that a hopeful issue may almost always be expected so long as the patients do not waste. The disease is characterized by periods of activity alternating with periods of quiescence, during which symptoms are more or less in abeyance and an ordinary active life can be led by the patient. During the quiescent stages, as a preventive, but especially during the active stages, rest and generous feeding are important points in the treatment, indeed a modified "rest cure," with all its increased nourishment, is the best means at our disposal for treating the active stages and distressing cardiac symptoms of this disease.

ORGANIC DISEASES

In considering the treatment of organic diseases of the heart it will be well to divide them into acute and chronic.

Acute heart disease.—Acute endocarditis and pericarditis can conveniently be taken together. The indications for treatment are: (1) To feed without loading the excretory organs with work. (2) To give plenty of fluid in order to promote fluidity of blood and sweating. (3) To increase or alter the nourishment under certain circumstances, such as cardiac failure, etc. (4) To be careful in selecting the most appropriate nourishment during convalescence.

1. In order to give the excretory organs, and the heart, as little work to do as possible, the diet should be fluid and consist chiefly of milk. Remembering that the function of the kidneys is impaired in these febrile, often rheumatic, conditions we should refrain from using strong meat essences. Moreover they undoubtedly stimulate the heart, and, in the majority of cases, we want to rest it. On the other hand, there are certainly some cases where the patient is weakly, anæmic and delicate, or where milk causes vomiting or distension, in which we must have recourse to essences and meat broths rather than an entirely milk diet.

2. We regard the free use of alkaline drinks as an important point in the treatment of acute endocarditis. They lessen the toxæmic state of the blood and probably diminish the tendency for thrombi to form on the valves, whilst, at the same time, they promote sweating.

3. In some cases where the cardiac action is very weak, we must overlook the rheumatic element in the case and give a more liberal diet, consisting of beaten up eggs, meat juices and the

lighter kinds of white fish. The greatest necessity for careful consideration of the diet occurs in those cases (mostly of pericarditis) where great cardiac depression, vomiting or a collapsed state supervenes. Here we must stop the exhibition of all drugs by the mouth, reserving the stomach for nourishment only. Digitalis is especially harmful; if necessary it (or strychnine) can be given hypodermically. The milk should be peptonized or well diluted with alkaline water, or citrate or bicarbonate of soda added in the proportion of 2 grains to the ounce. The feeds should be small and frequent, the actual amount and frequency regulated by the tolerance of the stomach. Strong meat juices and broths are often most useful to take the place of milk for a time. Stimulants may be necessary, brandy and champagne will generally be found most suitable. If there is absolute intolerance of the stomach for food, all feeding by the mouth must be discontinued for a time and recourse be had to nutrient enemata. This is most important, as vomiting throws a great strain upon the already embarrassed heart.

4. During the convalescence of acute endo and pericarditis the food must be increased cautiously. Increase of fatty food will be the first addition, such as cream, butter and fat of bacon. At the same time one may give farinaceous and milky puddings and custards. Eggs, fish and chicken may soon be added, with a little potato, well cooked green vegetables, and stewed fruit. Whilst admitting that, in exceptional cases, where the patient is very anæmic and debilitated, we do well to allow red meat rather early in the convalescence, one feels that its stimulating effect upon the heart, and its possibly acid producing properties are not usually desirable and that, in most cases (especially those of rheumatism), it should be the last item restored to the ordinary diet.

N.B.—One must emphasize the great difference between the treatment of acute and chronic heart troubles. In the chronic form so much of the treatment turns upon the judicious use of cardiac stimulants, whilst in the acute form stimulants, whether as food or drugs, except in quite rare instances, are best avoided. It has been pointed out that the food in acute endo and pericarditis should be selected for its non-stimulating characters. Further with regard to the use of alcohol, it must be laid down that, though it has been mentioned above as occasionally necessary in cases where there is imminent danger of cardiac failure, as a rule it is not advisable to use it at all; whilst the routine practice of giving it in all, or nearly all, cases of acute heart trouble is to be condemned as most harmful.

Chronic disease—morbus cordis.—Dietetic treatment of chronic heart disease will be influenced by the following considerations :—

1. The cause, e.g. rheumatism, gout, Bright's disease, etc.
2. The age of the patient.
3. The nature of the particular lesion present.
4. The condition of the heart as to :—
   (*a*) Perfect compensation.
   (*b*) Disturbed compensation.
   (*c*) Extreme failure.

1. The cause.—It is unnecessary here to discuss the best dietary for cases of rheumatism, gout, Bright's disease and so forth. They will receive full attention elsewhere. But it is necessary to emphasize the point that, when heart trouble has been caused by one of these diseases, it becomes more than ever important in its treatment to insist upon the appropriate diet being adhered to. If we wish the heart condition to get better, or at any rate to get no worse, we must see that its cause is not allowed to be a progressive one; and there can be no doubt that the course of such conditions as gout, rheumatism and Bright's disease can, amongst other things, be influenced profoundly by diet.

The reader is referred to the articles on the various diseases indicated, and is reminded that although the condition of the patient, or his heart, may need some modification from time to time in the régime there laid down, the main rules are usually applicable.

2. The age of the patient.—In adult cases a limitation of food is often beneficial and sometimes essential. Limitation of food is not, as a rule, wise in the case of children. The growth and development of the body has to be maintained, and a fairly liberal dietary will be found the best for them. Children under

ten years of age are notoriously bad subjects for heart disease; and although everything would seem to be in their favour, it is frequently the case that complete compensation is never attained. The formation of hypertrophy is often well carried out in children, the coronary vessels are healthy, there is no general arteriosclerosis, and yet we constantly see compensation only temporarily effected, soon to give way to dilatation and failure. The double call upon the vital powers for growth and development and at the same time for the establishment of a compensatory hypertrophy, and the extra work thrown upon the heart by the general development of the body prove too great a strain. It is a noticeable fact that this failure to create a permanent compensation is much more common among poor children than among those of the well-to-do, and although it may in part be accounted for by lack of care in other ways, insufficiency of proper nourishment is the main cause. What is true of acquired disease is even more so of congenital heart disease, and the prevalence shown for such cases to drift into acute or chronic tuberculosis makes a liberal supply of nourishment even more important.

It is important, therefore, in the case of children, not to keep them too long on a low diet when recovering from acute endocarditis, or when compensating after a temporary breakdown. When the trouble is over they should be fed liberally during the time compensation is forming. It is often necessary, in the case of adults, especially in those of full habit, to keep them on a somewhat low diet, though, except in cases of fatty infiltration, plethoric states and gout, starvation methods may easily be pushed too far. In the case of old people, a fixed régime is often harmful. It must be remembered that few real heart cases live to over sixty years of age, and if they do, they are generally feeble and debilitated, and need a free and liberal diet with a certain amount of alcohol. The general question of the use of alcohol in heart cases will be dealt with more fully later.

3. The nature of the lesion.—Probably in most cases of chronic heart disease it is wise to limit the consumption of fluids; but this is especially necessary where there is stenosis of a valve or extreme dilatation of one or more of the cavities. In such cases soups and broths should be avoided, the meals should be taken

as dry as possible and a limited amount of fluid, as drink, taken with or preferably in between them. The same rule holds good where the arterial tension is excessive or where dropsy is present.

In cases of fatty heart where there is infiltration rather than degeneration, and where the heart is more incommoded by the presence of the fat than actually diseased, a modification of the diet is generally necessary. Such patients are the victims of general adiposity. Fats and starches must be reduced to a minimum, and their diet should consist chiefly of fish, chicken, green vegetables and a limited amount of butcher's meat. It is generally advisable for such cases to take a rather increased amount of fluid in the form of water, and to avoid the use of alcohol. As a warning one must add that the depletion of the body fat must not be carried out too rapidly, and that as the fat on the body and round the heart is removed, it should be replaced as far as possible by muscle, and in order to attain this end massage, gymnastics and exercises are most helpful. Copious water drinking, a much restricted diet, various kinds of baths and a regular amount of exercise are remedies very easily enumerated, but nothing needs more careful thought and supervision than the decision as to how much each of these remedies should play a part in the treatment of any individual case. It is obvious that a patient cannot be drenched, starved and worked without very careful supervision, and much harm has been done by the reckless use of these methods of treatment without skilled advice. Further, although some cases of true heart disease are benefited by a somewhat modified course of such remedies, such a form of treatment is much more applicable to obese patients who are suffering from functional heart trouble only than to the victims of real morbus cordis.

For the sake of completeness the following dietary is given as suitable for a case of weak heart, especially when due to fatty overgrowth, and in patients whose heart trouble is due to overeating, overdrinking and deficient exercise :—

Breakfast.—About 6 oz. of weak tea or coffee, with a little milk, and 3–4 oz. of bread.

Midday Meal.—3–4 oz. of soup, 7–8 oz. of meat, bird or fish, salad or light green vegetable, 1 oz. of bread, toast, or milk pudding, 4–6 oz. of fruit.

Afternoon Meal.—About 6 oz. of weak tea or coffee and 1–2 oz. of bread or stale sponge cake or rusk.

Evening Meal.—1 or 2 soft-boiled eggs, 1–2 oz. of bread, cheese and salad and a little fruit.

With this diet, it will be found that some cases do better when restricted in the amount of fluid taken to between 30 and 40 oz. altogether, whilst others do better when taking an increased amount of fluid (chiefly water), better taken between meals.

As already stated exercise forms an important element in the treatment of these cases.

4. THE CONDITION OF THE HEART.—

(*a*) *Perfect compensation.*—Under these circumstances the patients are well, living an ordinary life, more or less, and in some of them no special care in diet seems necessary. It is always wise, of course, to avoid excess in either eating or drinking, and what has been said when speaking of the regulation of the diet according to the cause of the heart lesion is applicable to those whose hearts, although diseased, are causing no symptoms. In many compensated cases, however, probably in most, rather special care in matters of diet becomes necessary. Even where there are no symptoms, or when they are so slight as not to interfere seriously with the daily life, there is sufficient back-pressure to cause a chronic engorgement of the stomach, intestines and liver. Catarrh, arising from various causes, is very apt to occur under such conditions. It is, therefore, important to insist upon special attention being paid to the care of the teeth, prevention of oral sepsis, regularity and digestibility of food and to the avoidance of excess in eating or drinking, as well as the avoidance of mental or physical work in close connexion with a meal.

(*b*) *Disturbed compensation.*—It constantly happens that indigestion is one of the first signs to warn us that failure of compensation is imminent, or may first draw attention to the true state of the heart. All that has been said with regard to care in dietary becomes more important under these circumstances. In some cases there is intolerance of food, or such an amount of dyspepsia that the diet has to be chiefly fluid for a time. The continued use of irritating drugs, such as digitalis, may have made matters worse and it may be necessary to discontinue their administration by the mouth in order to get the stomach into a condition fit to digest food. As soon as possible solid, easily digestible food should be given in place of fluids, as better nourishment is needed, and it is often necessary to limit the amount of fluid taken. What has been said with regard to distension of the stomach and intestines with wind must be remembered here; and if fluid food, especially milk, is found to be causing it, measures must be taken to render it more easily assimilable by the addition of lime-water; bicarbonate or citrate of soda, peptonizing it, or it may be necessary to discontinue its use altogether for a time. However careful we may be with the diet, the symptoms will not be relieved unless, and until, the back pressure congestion is relieved by returning compensation aided by free purgation, so that the whole of the portal circulation may be eased by copious evacuations.

(c) *Extreme failure.*—There are no heart cases so difficult to feed as some of those in which there is complete failure of compensation, though fortunately this is not always so. The need for nourishment in order to promote returning strength is great; but such is the state of the digestive tract that the greatest care must be used so as to prevent complete intolerance of food. The tongue is frequently thickly coated, reflecting the condition of the stomach, and in some cases there may be vomiting or even hæmatemesis. It is well not to pay too much attention to the state of the tongue, as it will often be found that patients are able to take and digest their feeds well, although the tongue is very coated. Attention has already been drawn to the wisdom of feeding acute cases in young subjects liberally and rather early in the convalescence. Similarly in some instances of complete failure of compensation, where the state of the digestive tract would seem to contra indicate food, nevertheless it will be found that food is well borne and that improvement results from an increased amount of it. Where, however, there is definite intolerance of food, it is best, for the time, to stop all food and drugs by the mouth and to resort to hypodermic medication and rectal feeding. Later predigested food (peptonized milk and beef-tea) may be tried, but the return to ordinary food must be attempted very gradually indeed.

Alcohol.—It is in these cases of failing heart that we have the greatest need for alcohol. Many will prefer to use such drugs as digitalis, strychnine, æther and ammonia before resorting to its use, but most of us must admit that there are a good many cases which will not respond to the drugs mentioned above, and in which we are forced to have recourse to alcohol in some form or another.

Its advantages may be summarized as follows:

1. It will sometimes raise the force and quiet the tumultuous action of a failing heart when drugs have failed.

2. It frequently eases pain and distress as nothing else will.

3. In many cases it promotes sleep better and more safely than hypnotics.

4. Although it cannot be counted as a food, it often takes the place of and, temporarily at any rate, does away with the necessity for food.

Its dangers are these:—

1. It sometimes irritates the stomach and causes intolerance of food, at the same time engorging the liver.

2. It occasionally produces an exciting rather than a soothing effect on the nervous system.

3. Its prolonged use instead, or at the expense, of food will eventually precipitate and intensify complete cardiac failure.

It must not be understood that the indiscriminate use of alcohol is here advocated, but it is attempted to put it in its proper place as a most useful drug, to be used with discretion under circumstances where nothing that we know of answers quite the same purpose.

ANEURISM

The dietetic treatment of aneurism has undergone many changes, and a good deal of difference of opinion exists as to whether the diet should be particularly modified or not. We think that the starvation régime, so strongly recommended by Tufnell, is certainly unsuitable in many cases, and in some we believe it to be distinctly harmful. At the same time, there is no doubt in our mind that, in very many cases, a certain amount of restriction in food and drink is most beneficial. We must not condemn such measures as wholly useless because they are not absolutely curative. In such a progressive, and almost invariably fatal, disease as thoracic aneurism it is well if we find any method of treatment which arrests progress for a time and relieves the patient of some of his pain and symptoms. The rigid Tufnell diet consisted of: *Morning meal*: 2 oz. of bread and butter with 2 oz. of milk or cocoa. *Midday meal*: 3–4 oz. of meat with 2–3 oz. of potato or bread and 3–4 oz. of water. *Evening meal*: 2 oz. of bread and butter with 2 oz. of milk or tea. Poor, half-starved, anæmic and debilitated patients, or those broken down in health by syphilis (and most are syphilitic), or again, patients with bad heart disease and failing compensation in addition to their aneurism, especially aortic cases, do badly under such starvation measures, and should not be subjected to any such régime. But even in such debilitated cases, and certainly in others better nourished, and still more so in plethoric cases, certain modifications and careful selection in both the quality and quantity of the food and drink taken will be found beneficial. In some weakly individuals it will be found that a wholly milk and farinaceous diet is best at first; and this in spite of the somewhat increased amount of fluid taken. Soon, as their powers of assimilation increase, a drier and more strongly nitrogenous diet may be substituted, but it must be understood that a diet rich in animal food is not recommended, because it is more stimulating to the heart, whilst our object is to obtain as quiet a circulation as possible. It must be remembered that just as we inculcate complete rest of body in such cases, so we must be careful not to put any unnecessary work upon the digestive organs, and, therefore, it is essential that all food should be carefully selected as to digestibility and given at such intervals as to allow a proper rest between meals.

Alcohol is not to be allowed in such cases, unless it be evident that digestion fails without the habitual stimulant. In such cases it must be our aim gradually to diminish the amount taken until the patient can do without it altogether. As anginal symptoms are so frequent in cases of aneurism, the reader is referred to what is said under that heading for further points in the dietetic treatment of aneurisms.

ANGINA PECTORIS

In the treatment of patients suffering from "heart pang" the careful management of the diet is second in importance only to the need for rest. True angina will be treated here: anginoid attacks (or pseudo-angina) come more rightly under functional disorders, to which the reader is referred for its dietetic treatment. The frequency with which an attack of angina is caused by some dyspeptic attack or the ingestion of some indigestible food must have been the common experience of all, and it is only by the greatest attention to diet that patients who are liable to such attacks can be kept free from them. In many cases errors in diet have to be corrected and dyspepsia treated, for flatulent distension of the stomach or bowels must be carefully guarded against. All irritating food such as peppers and spices must be avoided. Strong alcoholic drinks come into this category and should not be allowed as a routine, though their efficacy in the treatment of the immediate attack must be allowed. In some cases the patients are weak and feeble and their powers of digestion much impaired; and with such cases a purely milk and soup diet is best to begin with. Indeed we shall have to peptonize even this form of nourishment in some instances. As they get stronger it is important to give flesh and fish, thoroughly minced and well cooked, rather than starchy foods. With those who are able to take, more or less, ordinary food the principles to be followed are these:

1. These patients need good nourishment.

2. They need nourishment in small bulk that will promote vigorous action of the heart.

3. The food must be most digestible, quickly digestible, and, above all, not such as will cause flatulent distension.

Of our mixed diet undoubtedly flesh in some form or other (meat, bird or fish) answers the above requirements most closely. Further, one must again urge the limitation of starchy foods, because of their slow digestibility and the flatulent distension so often caused by their use. Thus we have:

Milk, good strong soups (not spiced), meat, bird, fish (all carefully selected and well cooked). Eggs are permissible, as well as well cooked green vegetables (preferably rubbed through a wire sieve), the pulp of cooked fruit with cream, custards, junket and plain jellies. Tea and coffee are best avoided, and in any case, excess in their use must be looked for and strictly prohibited. Stimulants can only be allowed in a weak form and very small quantities. For drink water or any of its disguises, such as barley-water, toast-water, home made lemonade and so forth, with milk, is much the best, and in many cases fairly copious drinks of hot water are directly beneficial, by aiding digestion and elimination and preventing stasis, fermentation and flatulent distension.

DIET IN DISEASES OF THE BLOOD AND BLOOD-FORMING ORGANS

CHAPTER XXI

DIET IN DISEASES OF THE BLOOD AND BLOOD-FORMING ORGANS

By John Cowan, M.D., D.Sc.

The dietetic treatment of the anæmias is in many cases one of the most important therapeutic indications, for pathological conditions of the gastro-intestinal tract and the blood as a whole react upon each other with, sometimes, notable intensity. The relations of the two may, however, vary in different cases. In some instances the general condition is dependent on a gastro-intestinal cause; in others the connexion is the reverse; while in a third group both the general and the local symptoms own a common origin.

Empirical treatment is always unsatisfactory to the practitioner, but in this group of diseases must often be prescribed, as our knowledge of the causes which produce them is peculiarly meagre and deficient. Recent research has, however, thrown considerable light on some of the conditions which I have to consider, although the information available is still suggestive rather than definite; and at the present time a rational line of treatment can more often be dictated than was possible a few years ago.

In this article I shall consider chlorosis and pernicious anæmia at some length, and will refer to these sections for details in the subsequent paragraphs, so as to avoid reiteration as far as it is possible.

CHLOROSIS

We have still little knowledge of the causes of chlorosis, though innumerable theories as to its origin have been propounded at different times. Its onset has been ascribed to gastric indigestion, to constipation and auto-intoxication, to defective development of the sexual or of the vascular organs, and to functional nervous disturbances of various kinds.

The disease occurs mainly, if not exclusively, in girls, and as a rule in the years immediately following the onset of menstruation, though relapses are not uncommon during the succeeding decade. It affects all ranks of society from the highest to the lowest, and an hereditary tendency may be noticed, the women of successive generations being sometimes affected, and often more than one member of an individual family. Chlorotics are not necessarily unfertile, indeed they are often the reverse ; and an attack, if fully recovered from, seems to have no influence on the duration of life.

It is manifest that a disease of this description can hardly be related to defective development of the sexual or vascular viscera, and digestive disturbances, however important they may be, and no one doubts their influence, can evidently have no essential bearing, or they would produce similar symptoms in the opposite sex. The cardinal factor in the etiology must be a sexual one, and any theory which assumes the contrary necessarily falls at once. But, although many theories have been brought forward, the evidence available is still insufficient to supply a satisfactory answer.

Although the essential factor is still unknown, a large mass of information is now available with regard to the secondary, or contributory, causes. In probably the majority of cases the personal hygiene is found to have been defective.

Chlorosis is thus peculiarly common among domestic servants, perhaps as a result of their long hours of indoor work, of physical exertion out of proportion to their physique, of insufficient amount of sleep, or imperfect ventilation of their living or sleeping rooms. But it is by no means infrequent among girls reared in comfortable homes, where these causes should apparently be inactive. The comparison may however be apt ; lawn tennis and riding may represent the physical strain ; balls and entertainments may allow little time for sleep ; and the hot air of the theatre or crowded drawing-room may be even more vitiated than that of the kitchen. Overwork may be mental as well as physical, and long school hours and constantly recurring examinations may exert their own pernicious influence.

At this particular stage of development dietetic errors are apt to occur, for the girl is passing from the strict supervision of the schoolroom to the freer habits of the adult, and "the likes and dislikes" of the child are apt, in consequence, to be perpetuated, and even accentuated. Schoolroom routine, too, may prove disadvantageous, for although, as Pawlow has shown, suitable digestive secretions are elaborated for each individual meal, still gross variations in the diet cannot at once be accommodated, and digestion in such cases is necessarily imperfect; and the consequent discomforts may provoke still further deviations.

The diet of chlorotic girls thus almost invariably requires close supervision. In the majority of cases it will be found to be defective, and as a rule the protein and fatty intake is deficient, while the carbo-hydrate consumption may be excessive; the total quantity, too, is sometimes insufficient. In a small number of cases the diet is actively injurious, such substances as vinegar, dry rice or coffee, or highly spiced and seasoned foods, forming the large proportion of the daily diet.

Dietetic errors may, of course, arise from other causes than the mere whim of a growing girl, and among hospital patients, poverty and ignorance are probably the most important.

In another large group of cases gastro-intestinal symptoms occur, and exaggerate any initial error. In many cases they seem to precede the onset of the disease, and they have been considered by some as its cause rather than as its result; but they not infrequently ensue subsequent to the onset, and in other cases again may be wholly absent throughout the whole illness.

Gastric symptoms are the most frequent, and may be of varied severity. In the slighter degrees a feeling of fulness after food, flatulence and eructations, are the main features, but actual pain, more or less severe, and vomiting, sometimes persistent and repeated, may be experienced; and in a small proportion, definite evidence of gastric catarrh or ulceration may obtain.

Intestinal symptoms are also common. Constipation occurs in greater or less degree in probably more than half of all cases; diarrhœa is comparatively rare; while flatulence and colic are not uncommon, and are usually associated with stools that are offensive in their odour, and abnormal in their colour and consistence.

Various explanations of these symptoms have been brought forward, and careful examination usually reveals some abnormality in the gastro-intestinal tract. The teeth, for example, are often wanting, and thorough mastication may be impossible; or they may be carious and septic, with surrounding inflammation, or even pyorrhea alveolaris. It is always advisable to examine the mouth thoroughly after the removal of any artificial teeth. The cheap dentists, whom servants girls attend, often saw off carious teeth flush with the gums, and apply a plate on the top; and a row of ivory white incisors may conceal a hidden septic focus, which, however, generally gives evidence of its presence by the offensive odour of the breath.

Careful examination of the stomach may reveal abnormal conditions. It is sometimes enlarged, or displaced downwards or to the side; and the gastric secretions are very frequently imperfect. There is still some discussion as to the usual findings, but the hydrochloric acid is often excessive, rarely of average amount, and occasionally deficient or even wholly absent.

Several writers have endeavoured to prove that the abdominal symptoms are the result of ill-fitting or too tightly laced corsets, which interfere with the proper position and action of the muscular viscera; but while extreme examples may produce such interference, the general weakness of the muscular walls must also help, and the symptoms are sometimes notable without any gross fault of this kind.

In another group of cases, the most careful examination fails to reveal any abnormality in the gastric functions, and the symptoms must be ascribed to mere gastric hyperæsthesia.

It is evident from the above that the dietetic treatment of chlorosis is one of the main indications which has to be followed, and a satisfactory result is little likely to occur until the gastro-intestinal functions are performed easily and well. A gastric ulcer or gastritis of course requires treatment of its special kind, which, however, is considered in detail elsewhere.

Whenever the gastric symptoms are severe, the patient should be kept in bed at absolute rest; for the defective intake entailed by their presence, tends to exaggerate the prevailing malnutrition, which, however, is minimized by the cessation of active exercise. Rest, too, is an excellent therapeutic measure in almost all gastric disturbances, and the symptoms are often rapidly lessened or abolished, quite apart from any special medication.

If vomiting is frequent, oral alimentation should be stopped for a few days, only sips of hot water containing bicarbonate of soda (10 gr. to 1 oz.) being allowed; and a mustard plaster may be applied to the epigastrium. Nutrient enemata may be utilized, but large saline injections (3 to 4 pints in the 24 hours) are usually sufficient to tide over the few days required. If vomiting is not severe, some oral alimentation is generally possible even at the outset. Milk, when diluted, is as a rule well borne and may be given at first in ounce doses every hour. Bismuth carbonate and soda bicarbonate may be given in addition, with hot applications to the epigastrium. As the symptoms subside, the quantity of milk should be rapidly augmented, hourly feeds being continued until two pints of milk are taken in the 24 hours, the interval between doses being thereafter slowly increased. Four to eight pints of milk can frequently be digested easily and without discomfort, but the stools should be examined regularly for undigested curd. In some cases the vomiting is persistent, or the milk is ill borne. It may be made more digestible by being citrated, "soured," or peptonized, and more palatable by the addition of weak freshly infused tea or coffee as flavouring agents, or in the form of curds or junket. Whey, mixed with white wine, and albumin water are sometimes of value in severe cases.

Gastric ulcer is so frequent an accompaniment of chlorosis that its presence should be suspected in every case where acute pain accompanies the ingestion of solid food, even without the characteristic vomiting and epigastric tenderness. It is always wise to keep such patients on a purely fluid dietary until the bowels have been freely emptied, and the absence of blood from the stools determined. In many cases it takes several days to ensure such a result, as the constipation is often obstinate and scybalous material continues to be present in the stools.

In every case where the pain is acute, oral alimentation should be entirely stopped, and gastric sedatives, with opium if necessary, given in adequate doses. In the less severe cases the symptoms as a rule rapidly abate with absolute rest and a fluid diet. It is generally wise, however, to refrain from the administration of solid food of any kind until undiluted milk is utilized without discomfort, or the administration of gastric sedatives.

During this period any notable oral defects should be rectified. It is of course impossible to thoroughly empty the mouth of all carious stumps; but repeated and thorough cleansing of the teeth with mild antiseptic solutions (glycerine of carbolic acid, boroglyceride, hydrogen peroxide) speedily alters the complexion of affairs.

The gastric symptoms being in complete abeyance, the mouth moderately clean, and the bowel thoroughly emptied, solid food may now be commenced, but advances should be made gradually. The less coarse forms of farinacea (semolina, arrowroot, tapioca, bread and milk) should be used, and in the absence of symptoms their quantity may be fairly rapidly increased, though large amounts are rarely permissible as long as sedatives are required for gastric comfort. Dry toast, rusks, ground rice, Robinson's patent oat flour, may be added for the sake of variety, the quantity of milk consumed being still four or five pints. On such a dietary the patient's weight as a rule begins to increase within two or three weeks.

The next addition to the dietary should be made as gradually as the first. Small whiting, soles or haddock, plainly boiled with a white sauce, or as a soufflée, and lightly boiled or poached eggs, are usually well borne, and as soon as a fair quantity is being taken the carbo-hydrate and milk intake may be correspondingly decreased; but a couple of pints of the latter should be still continued. A small tumblerful may be taken with the solid meals, and the rest at appropriate intervals.

An unrestricted dietary is rarely permissible until the blood count is normal. The tendency to hyperacidity must be borne in mind, and any excess of carbohydrates, especially the coarser varieties, is apt to rewaken the symptoms. Potatoes, pastry and vegetable soups are particularly unsatisfactory in this respect.

There is, however, no contra-indication to the finer meats, such as chicken, tripe, rabbit, fresh young birds, and even mutton, provided that they are plainly cooked (roasted or boiled) and thoroughly masticated. If mastication is impossible from the absence of teeth or tenderness of the gums, these foods may be given in the form of cream or mince.

The common deficiency in the fatty foods requires attention. Milk of course contains a fair proportion of fat, but it should be reinforced with cream as early as possible, and butter should be taken freely. Fat bacon and sardines are other food-stuffs which can often be made use of. Pears and apples, if thoroughly stewed without an excess of added sugar, are often well borne, and can be taken with cream.

In the more severe cases four to six weeks of a milk and carbo-hydrate diet may be required to allay the symptoms, but in the large majority of patients in whom dyspeptic symptoms obtain, a much shorter period is sufficient, if the patient is kept from the outset at absolute rest in bed ; and the rapidity with which abdominal symptoms disappear under this régime is sometimes very striking. Even in cases where gastric symptoms are wholly absent, rest in bed is advisable for a week or two at any rate, particularly in those patients whose appetite is defective or capricious ; and the initial improvement may be rapidly continued when a fair amount of outdoor air and exercise is subsequently allowed.

Few chlorotics require such a lengthy and careful restriction of their diet. In many but little restriction need be imposed, a plainly cooked diet of *fresh* foods with a suitable proportion of carbo-hydrates, fats and proteins being successfully utilized ; but, on the other hand, few of these patients can be allowed to continue their old habits, as the quality or the quantity of their food-stuffs is generally found to be defective. And the diet must be supervised for several months after recovery, if relapses are to be avoided.

The dietetic treatment of chlorosis is of course subsidiary to the administration of iron. *It is rarely judicious to administer iron in any form so long as a milk and carbo-hydrate dietary is* *required; and digestive disturbances should be in complete abeyance.*

Constipation, when present, requires very special attention, and drugs may be needed to ensure the daily evacuation of the bowels. If gastric symptoms are absent dietetic measures may be sufficient, a bulky and more or less irritating food residue securing the desired result. Brown bread, porridge, marmalade, fresh or stewed fruits (especially apples, pears, prunes, figs), the green vegetables, bananas, etc., may be employed; but it should always be remembered that the last named is the not infrequent cause of a mild form of colitis. It is usually well borne if cooked.

Drugs are generally required so long as the patient is upon a milk or farinaceous diet. Large enemata, frequently repeated, defeat the end in view, and should only be given as occasional helps; but glycerine enemata are often successful. Of drugs, Carlsbad water, sulphate of soda, castor oil, liquid extract of senna pods or of cascara, and the B.P. Pil. aloes et ferri, are those most useful. The saline sulphates have been decried on theoretical grounds, but practical experience seems to contradict the theory.

In a very small proportion of cases the digestive symptoms seem related not so much to actual gastric disability as to a hypersensitiveness, the result of the anæmia; and a successful issue can only be attained by improvement of the condition of the blood. Such cases are, however, the exception. There is generally a notable disproportion between the severity of the symptoms and the complaints; the patients are, as a rule, palpably neurotic; and there is an entire absence of objective evidence of gastro-intestinal wrong-doing.

The majority of patients suffering from gastric symptoms, however, require careful attention, and are speedily relieved by such a course of treatment as is indicated above, and any measures adopted on the supposition that the symptoms are neurotic in their origin should be carried out tentatively and with care.

The main difficulty in the treatment of chlorosis is the decision as to how radical the treatment should be. Is it necessary to confine this patient to bed and to a fluid diet? Or may a limited amount of exercise and a solid dietary be adopted from the start?

It is as a rule far more satisfactory to err on the safe side in such cases, and if the symptoms disappear rapidly, an equally rapid transition through the various stages can easily be made. On the other hand, continuance of the symptoms and a retrogression in the treatment is always disappointing from the patient's point of view.

Whenever sedative drugs are required, the dietary should be restricted to milk, or at any rate, the finer farinacea. There is no objection, however, to such aids to digestion as alkalies, pepsin and bitters, and small doses of these are often of value in promoting appetite or digestion.

DIETS

Milk Diet

4 a.m.	Milk, 10 oz. (hot or cold).
8 a.m.	Bread and milk, 15 oz.
11 a.m.	Egg flip, 10 oz.
1 p.m.	Milk pudding with milk, 15 oz. (Cornflour, ground rice, semolina, sago, tapioca, arrowroot, custard).
3 p.m.	Benger's food, 10 oz.
5.30 p.m. . . .	Milk pudding or bread and milk, 10 oz.
8 p.m.	Milk, 10 oz.

The quantity of milk may be increased to 4–6 pints in the twenty-four hours.

Light Diet

4 a m.	Milk, 10 oz.
8 a.m.	Milk or weak tea with milk, 10 oz. Bread and butter, 2 oz. White fish, boiled, with white sauce, 4 oz. Or an egg, lightly boiled or poached.
11 a.m.	Milk, or Benger's food, 10 oz.
1 p.m.	Chicken or white soup, 10 oz. Chicken or white fish, 4 oz. Bread, 1 oz. Potatoes, 2 oz. Vegetables, 1 oz. (cauliflower, cabbage, sprouts, etc.). Milk pudding, 10 oz.
5.30 p.m. . . .	Milk or weak tea with milk, 10 oz. Bread and butter, 2 oz. An egg, or white fish, 4 oz.
8 p.m.	Milk,10 oz.

Cream, 10 oz. per diem.

Full Diet

4 a.m.	Milk, 10 oz.
8 a.m.	Milk or weak tea with milk, 10 oz. Bread and butter, 4 oz. White fish, 4 oz. Or an egg.
11 a.m.	Milk or Benger's food, 10 oz.
1 p.m.	Soup, 10 oz. Meat, boiled or roasted, 6 oz. (chop, steak, mince, mutton, chicken). Bread, 2 oz. Potatoes, 2 oz. Milk pudding, 10 oz.
5.30 p.m. . . .	Milk or weak tea with milk, 10 oz. Bread and butter, 4 oz. An egg, or white fish, 4 oz.
8 p.m.	Milk, 10 oz.
	Cream, 10 oz. per diem.

These diets, which are in use in my wards, have proved satisfactory in the large majority of anæmic cases. In private practice they have usually to be modified, but the general idea is maintained. The meals are taken at comparatively short intervals, and the chief meal is in the middle of the day, and is followed by a relatively long interval.

Patients, when on full diet, should rest quietly for at least half an hour after the larger meals, and for the same period before them; and efficient mastication must be insisted upon. Every effort should be made to ensure a sufficient variety in the food-stuffs so as to encourage appetite.

When constipation is persistent, the chief alterations in the diet are the substitution of brown bread for white, an increase in the amount of the green vegetables, and the addition of porridge and such fruits as are in season, in particular apples, pears and bananas. The fruit jellies, marmalade, dried or stewed plums, prunes and figs may also be used.

The following " card " of " fresh foods " is often useful.

Bread, unsweetened biscuits, scones.
Butter, jellies, marmalade.
Milk puddings (cornflour, arrowroot, sago, tapioca, semolina, rice).
Thick soups (white, potato, barley, etc.).
White fish (sole, whiting, haddock, cod).
Fresh young birds (chicken, pheasant, partridge, grouse).
Beef, mutton, tripe, rabbit.

Potatoes, cabbage, Brussels sprouts, cauliflower, peas, beans, lettuce, tomatoes.

Grapes, strawberries, melons, bananas (in moderation), oranges, apples, pears.

Milk, cream, curds and whey.

Eggs, custard.

Tea, to be infused for three minutes, and mixed with nearly an equal quantity of milk.

No dried, salted, tinned, or preserved foods of any kind are allowed, save . . . . food, which may be added to the milk, and bacon.

The food must be roasted, boiled, stewed, or broiled. Sauces must not be highly seasoned. *Condiments are to be used sparingly.*

Fish Soufflé

Six oz. haddock or whiting; 2 oz. butter; the yolks of three eggs and the whites of four; 2 oz. flour; 8 oz. fish stock; pepper and salt.

Remove the skin and bones from the fish, and after pounding the flesh thoroughly, pass it through a fine sieve. Put the butter and flour into a saucepan and rub together over the fire; add the fish stock, and stir until it boils. Add in order, pepper, salt, the fish pulp, the egg yolks and lastly the egg whites, which have already been beaten up stiffly. The mixture is poured into a well buttered tin, and baked in a moderate oven for 45 minutes.

Chicken Cream

The breast of a young chicken; pepper; salt; a small teacupful of cream.

Pound the chicken thoroughly and pass it through a fine sieve. Place the pulp in a small basin, with the pepper and salt, and beat with a fork for ten minutes, adding the cream very gradually. Place the mixture in a well wetted mould, cover with paper, and poach for twenty minutes in boiling water.

PERNICIOUS ANÆMIA

Pernicious anæmia contrasts in many ways with chlorosis. It is not confined to the female sex, occurring as it does a little more frequently among men than among women; nor to any particular age, as it has obtained at the ages of 5 and 73, though it is most common in the third and fourth decades. Heredity, so far as is known, has but little influence, and while chlorosis scarcely interferes with the duration of life, unless from accidental complications, the tendency in pernicious anæmia is generally towards a fatal issue, though temporary rallies may prolong the patient's life for, sometimes, a period of years.

It is extremely probable that the disease is the result of an abnormal hæmolysis in the portal tract. The deep colouration of the skin, urine, and stools all point to increased destruction of red blood cells, and the fact that post-mortem examination reveals the presence of iron in abnormal amount in the periphery of the hepatic lobules, indicates the special site. Changes, too, are often found in the gastro-intestinal tract. Both the stomach and the intestines may be affected. The mucous membrane is pale and perhaps shows even numerous capillary hæmorrhages. It may be thinned, atrophic, or the site of fibroid changes, though these latter are uncommon; or present evidence of catarrhal processes of varying extent and intensity.

The exact character of the primary fault is, however, as yet undetermined. Dr. William Hunter is the chief advocate of the theory that pernicious anæmia is the result of a specific gastro-intestinal infection. He has pointed out the general resemblance of the disease to the chronic infections, and has emphasized the frequency with which gastro-intestinal symptoms and lesions are met with. In his early papers he drew attention to the lesions that might be present in the mouth; cario-necrosis of the teeth, gingivitis, pyorrhœa alveolaris, and glossitis, often of peculiar severity and persistence; and he has isolated micro-organisms from both the gastric and the intestinal contents. The febrile paroxysms, he thinks, correspond to exacerbations of the infective process, while the intoxication is at any rate subacute during the afebrile periods.

In the present state of knowledge, the question cannot be considered as settled, as a specific organism has not as yet been isolated, or the exact site of the process determined. It may be in the stomach or bowel, or in both, or these may be simply the portal of the infection, and the actual site may be visceral.

If Dr. Hunter's theory is correct, the indications for treatment will vary during the different stages of the malady. In the quiescent periods, the main indication is the improvement of the general nutrition, the abdominal condition being more or less ignored; while during the febrile paroxysms, attention should be paid to the gastro-intestinal tract in particular, and the local irritation allayed as a preliminary step.

Our present state of ignorance concerning the bacterial processes in the bowel as a whole, even during health, entails a line of treatment which is necessarily empirical and tentative. But certain indications seem sufficiently clear, and the question must be considered from the standpoints of the bacteria themselves and the nutritive materials on which they grow.

It is evidently advisable to limit, so far as may be, the entrance of additional bacteria into the parts. It is manifestly impossible to completely sterilize the food-stuffs, and such a procedure is contra-indicated for other reasons ; but care should be taken that obviously infected material (high game, dirty milk, etc.), is not ingested ; and any septic focus about the mouth should be attended to, in the way already described.

If there is any evidence of gastric infection, the stomach should be washed out regularly. Antiseptic drugs, such as sulphocarbolate of soda, carbolic acid, etc., are also of use, but the mechanical douching of the mucous membrane is much more efficacious. Herter and others have recommended similar treatment, when the symptoms point to infection of the large bowel. The former recommends the passage of the soft tube as high as is possible, and the slow introduction of fluid in quantity ; and he states that he has seen notable improvement in the blood counts after such measures.

It is, of course, impossible to apply treatment of this character to the small bowel ; and the results of the administration of antiseptic drugs, such as naphthol, salol, etc., are usually disappointing, even when such measures as keratin capsules and the like have been utilized. An occasional purge will of course assist, but frequent purgation will inevitably lead to defective nutrition from the loss of food material. The condition can be best attacked in other ways.

The degree of bacterial infection (that is to say the numbers of bacteria present) depends very largely upon the amount of nutritive material that is available for them. In the absence of food-stuffs, their numbers rapidly lessen. The food should, in consequence, be presented to the small intestine in such a form as will lead to its *rapid* digestion and absorption.

It may be urged that the lesion in pernicious anæmia is an infection of the tissues and not an intoxication derived from decomposing food. There is but little direct evidence in favour of either supposition; and even supposing that the former theory is correct, tissues freed from the continuous absorption of the products of decomposing food are surely much more likely to cope successfully with an infection than tissues exposed to such influences.

Anorexia or gastric symptoms of any kind may prove a serious hindrance to the administration of food. In these cases it is generally advisable to confine the patient to bed, though as much fresh air as is possible should be provided. The dietary should then be largely fluid, but it is probably wrong to restrict the variety or the amount of food-stuffs to the degree that may be necessary in the case of such a disease as chlorosis. The anæmia tends to impair the digestive secretions; the imperfect absorption of food leads to further deterioration of the blood; and the vicious circle perpetuates itself.

Milk is sometimes badly borne by these patients. The gastric juice is often defective in HCl and pepsin, and both may be wholly absent and gastric digestion in abeyance. But an attempt should always be made to ensure the consumption of a certain amount, and any of the artifices already suggested may be utilized. Peptonized milk rarely gives rise to symptoms, but the taste may interfere with its consumption. White wine whey, whipped eggs, egg-nog, meat soups, beef-tea, etc., may be utilized if milk cannot be taken, and their nutritive value may be increased by the addition of extra protein in the form of protene, plasmon, etc., or of some of the finer farinacea.

It must be acknowledged that a fluid dietary is much less frequently successful in pernicious anæmia than it is in chlorosis; and if the symptoms continue, variations in the diet should be made. Much help may be got by careful examinations of the stools for undigested food débris, etc.; and by the analysis of the gastric contents after a test meal, if such a procedure can be adopted; but the weakness of the patient may interdict the passage of the stomach tube.

A small easily digested solid dietary should next be essayed. Oysters, eggs, lightly boiled or poached, the finer white fish, underdone meat, if necessary finely minced or scraped, raw meat juice, scraped raw meat, preferably given as sandwiches, raw or lightly cooked ox marrow, are sometimes tolerated when a more bulky fluid diet is ill borne. The cooking, however, must be of the plainest variety, and rich sauces or large amounts of condiments must be prohibited. On such a dietary intestinal symptoms sometimes subside with great rapidity.

A largely protein dietary of this kind is almost invariably attended by great fœtor of the stools, and the amount of indican and aromatic sulphates in the urine is generally notably augmented. The bowel should in these patients be flushed out at intervals, so as to limit as far as possible the intestinal decomposition. The administration of antiseptic drugs has on the whole proved unsatisfactory. Mercury in small doses is probably the most generally useful.

The chief objections to the use of raw meat are the disagreeable flavour, and the impossibility of ensuring a sterile diet. The former may be overcome by a partial cooking; the latter by utilizing the central parts of the flesh. The tapeworm parasites, etc., may of course be conveyed in such a way, but the danger in this country is probably less than elsewhere. In India it is said to be considerable.

The cases in which gastro-intestinal symptoms are in abeyance should be fed on ordinary lines. A fairly varied mixed diet of *fresh food*, with a maximum of the red meats and a fair proportion of milk, is usually well digested; but a careful watch should be kept upon the stools to ensure that digestion is complete. Fever *per se* is no contra-indication to even over-feeding, if the digestion is good, but the coincidence is, unfortunately, often lacking.

THE SPLENIC ANÆMIAS

The association of anæmia of a severe type and enlargement of the spleen has been recognized clinically for many years. In a considerable proportion of these cases the enlargement of the spleen is due to some well recognized cause, such as hepatic cirrhosis or amyloid disease, but in a certain number the recognized causes are absent, and it seems probable that we have to deal with a specific disease of unknown origin. The disease is essentially chronic, and is not incompatible with fair health for many years (25–30). It may occur at any age, but the infantile and adult types vary to some extent, and had better be considered separately.

In the adult form, the disease seems to occur most frequently between the ages of 20 and 40, and does not affect either sex in particular. In well marked cases the spleen is notably enlarged and the liver may also be increased in size. The patient is anæmic, and the skin is often diffusely pigmented. Gastro-intestinal symptoms are not uncommon, in particular gastric hæmorrhage which is often profuse, and diarrhœa. The course of the illness is very chronic, but the anæmia on the whole progresses, and death ensues from hæmorrhage, complications or asthenia. A terminal cirrhosis of the liver with ascites (Banti's disease) is not unusual.

Splenic anæmia may also occur during infancy, though we are still ignorant as to whether it is the same disease as the adult form, or *sui generis.* It is met with most frequently in the second year of life, and is generally associated with some degree of rickets. The infants are notably emaciated and anæmic, and sometimes of lemon yellow complexion. The liver and lymphatic glands may be enlarged as well as the spleen. Gastro-intestinal symptoms are the rule, vomiting and diarrhœa being the most frequent.

The general resemblance between splenic anæmia and pernicious anæmia is somewhat striking, but the lack of information on a large scale prevents any close comparison. The colour of the skin is sometimes very suggestive, and a megaloblastic type of blood is the rule in the infantile cases, and sometimes occurs in adult cases. Oral sepsis and gastro-intestinal symptoms may also occur.

With our present knowledge treatment in the adult cases should be based on the lines suggested in the pernicious anæmia section, and the diet should be bland and suited to the digestive power. The tendency to gastric hæmorrhage must be remembered, a tendency which is probably due to mechanical derangements of the venous supply produced by the splenic tumour, and any distension of the stomach by large quantities of food, flatulence, etc., or unnecessary irritation by irritating viands, should be avoided so far as is possible.

The gastro-intestinal symptoms in the infantile form are usually well marked and call for special treatment. Diarrhœa is probably the most common, although vomiting may be persistent and severe. The stools are generally offensive, often green in colour, and may contain much mucus and undigested food. The dietary suitable for these symptoms is considered in the section on Diseases of Children. When gastro-intestinal symptoms are in abeyance, the diet should be that suited to the particular age, but special care must be taken to prevent infection of the milk ingested, and to prevent or remove any septic condition in the buccal cavity, which may be as marked during the first dentition as during the second.

THE SECONDARY ANÆMIAS

The diet in the "*secondary*" anæmias requires but brief consideration. It is essential to recognize the wide range of conditions which may produce anæmia. General and local infections, intoxications of divers kinds, starvation relative or absolute, overwork mental or physical, worry, insanitary surroundings and defective personal hygiene, may be the active agents, and recovery in any case is not likely to occur until the particular cause no longer operates. When this is fulfilled, the results of treatment are usually satisfactory.

A full mixed diet is rarely if ever permissible unless the tongue is clean, the stools normal, and digestion easy and active. The dietary should be prescribed on the lines laid down in the section on Chlorosis.

The secondary anæmias of infancy and childhood may of course result from causes of the same kind and variety as those active in adult life ; but dietetic errors and gastro-intestinal disturbances play on the whole a more important part than is the case in adult life. The growing child shows the effects of relative starvation very rapidly, and the slighter faults produce a more serious result. The dietary should thus in every case be carefully revised and any defects rectified; while gastro-intestinal symptoms must be treated on the lines required.

THE LEUKÆMIAS

The symptoms in the leukæmias are in the main of a general kind, the direct result of the associated anæmia; and in the later stages of the disease, may, as in any severe cachexia, be related to the alimentary tract. Such symptoms, however, occasionally arise at an early period, and are then usually connected with abdominal lesions.

Enlargement of the spleen, which is so often extreme in the myelogenic cases, or of the abdominal lymph glands in the lymphatic cases, may thus produce, by their mechanical interference, pressure symptoms of varying degree; and in both forms specific lesions may occur in the tract.

Any section of the bowel may be involved, and the lymphoid tissue is particularly affected. The tonsils and pharyngeal lymphoid tissue may thus be notably enlarged; the solitary glands of the stomach are occasionally implicated; but the most common site is the Peyer's patches and solitary follicles of the bowel, particularly in the vicinity of the ileocæcal valve.

A diffuse leucocytic infiltration is sometimes met with, most commonly in the acute lymphatic cases and affecting the gums. The tissues become swollen and may even hide the teeth, around which ulcerative processes arise; and the ulceration may become extreme, with great fœtor of the breath, a foul smelling ichorous discharge, and sometimes severe hæmorrhage. The lymphoid enlargements in the bowel may also ulcerate, and diarrhœa may be severe and persistent, and occasionally associated with hæmorrhage.

Alimentary symptoms are often absent in the early stages of the chronic leukæmias, the appetite being satisfactory and the digestive functions easily and well performed. But even at this stage, splenic enlargement may occasion discomfort or a feeling of fullness after meals. Anorexia and flatulence may be troublesome, and the bowels may be difficult to regulate, periods of constipation alternating with spurts of diarrhœa.

As the disease progresses, the symptoms may become severe. Appetite may be wholly lost and the ingestion of food accompanied by nausea and occasional vomiting. Diarrhœa may be persistent and severe. Hæmorrhage may occur even without the formation of ulcers, though it is most profuse when this obtains. Hæmatemesis is comparatively rare and is seldom extreme ; bleeding from the bowel is more common, and is not infrequently the immediate cause of death.

In acute lymphatic leukæmia the hæmorrhagic tendency is often well marked at an early stage. Hæmorrhage may occur from the nose or the mouth, more particularly in those cases where local necroses or ulcerations are present, and may be profuse and continued. Gastric hæmorrhage is more common than in the chronic cases, and intestinal hæmorrhage is frequent. Vomiting may be troublesome ; diarrhœa occurs in the majority of cases.

As we are still wholly ignorant of the causes of the leukæmias, the dietetic indications must be based upon our knowledge of the general tendencies of the disease, and on the actual condition of the patient.

A generous diet is thus indicated in cases where the alimentary symptoms are slight or in abeyance, the meals being composed of the more easily digested foods, and irritating items prohibited. The meals should be moderate in amount, so as to avoid undue distension of the stomach, and must thus be fairly frequent, and a diet with a large food residue should be avoided. Laxative medicines must always be of the milder varieties.

Special attention should be paid to the toilet of the mouth in those cases where oral symptoms are present, and the food must be fluid or semi-solid. Milk will form the main staple, and should be given in as large quantities as can be tolerated, predigested in whole or in part if gastric digestion is difficult or delayed, and reinforced, if possible, by the addition of the finer farinacea or some of the protein preparations. Meat extracts, raw meat juice, etc., are sometimes well borne.

When gastric symptoms are severe, the food must necessarily be fluid and administered in small quantities at a time, but every effort should be made to ensure the retention of as large a quantity as is possible, for starvation is badly borne, and rectal feeding can rarely be carried out satisfactorily for any length of time. Peptonized milk, "soured" milk, buttermilk, citrated milk, or whey, are often of value.

Diarrhœa, when severe, is sometimes very intractable and persistent; but if gastric digestion is fair, a considerable amount of nourishment may be afforded. The farinacea are probably of less use than protein foods in such cases, and the finer fibred fishes (whiting, soles, etc.), chicken, sweetbreads, oysters, may be utilized as well as milk and eggs. The pancreatized carbo-hydrate preparations, such as Benger's food, are to be preferred to the malted articles.

The usual drugs may afford help; and while the astringent preparations are sometimes of value, opium is probably the most generally useful, and is usually well tolerated, even in considerable doses.

HODGKIN'S DISEASE

The lesions in Hodgkin's disease are in many ways comparable to those which may occur in the leukæmias. The spleen and the abdominal lymph glands may be enlarged and the lymphatic tissue of the bowel may be involved, and symptoms of a similar nature may thus be invoked.

Gastro-intestinal symptoms are, however, less frequently met with and need scarcely be discussed in detail. Treatment must be conducted on ordinary lines.

SCURVY

At the present day scurvy presents few terrors to the inhabitant of the civilized world, for the means of inter-communication are now so rapid and cheap that practically every variety of vegetables and fruit can be procured at any season of the year, and the possibility of a vegetable famine is remote. To the explorer, however, and the resident in besieged cities, the problem of the prevention of scurvy will always remain, and its effects are writ large in the cemeteries of Port Arthur and of Paris.

Sporadic cases of scurvy do, however, now and then occur even in English towns, and may escape detection on account of their rarity, and there is little doubt that some cases of prolonged fever (enteric, for example) are followed by a protracted convalescence from their complication by this disease, usually the result of the prolonged use of sterilized or boiled milk. Frontier medical officers are well acquainted with the association which is of necessity more common among their patients, and are in consequence accustomed to seek for its effects in their malarial and dysenteric patients.

The essential point in the etiology of scurvy is the undisputed fact that a plentiful diet of fresh vegetables cures the disease. The converse proposition is not, however, equally true, and a dietary wholly devoid of vegetable elements is not necessarily provocative of the disease. Many of the residents in Arctic regions, for instance, live exclusively on an animal diet during the winter months, and Nansen and his companion lived without harm for nine months on Frederick Jackson Island on a diet of fresh walrus or bear's meat, without any fresh vegetables or lime juice. Babies at the breast, too, rarely if ever develop the disease, though it is not uncommon after the infant has been weaned.

The exact nature of the fault is, however, undetermined. Garrod suggested that the disease was due to a deficiency in the potash salts, while Buzzard considered that the organic potash salts were the vital factors. Ralfe thought that the disease was due to a deficiency in the alkalinity of the blood, and Sir A. E. Wright has recently investigated the point. He has shown by direct measurement that the alkalinity of the blood is lowered in cases of scurvy, and that the normal is regained with the cessation of symptoms. Vegetable food-stuffs contain an excess of bases over mineral acids, while meat and cereals contain an excess of mineral acids over bases ; such foods as corned meat containing even less base from the abstraction of the blood and lymph during the process of preservation. The acid intoxication which results is, in his opinion, the immediate cause of the symptoms, and the essential treatment consists in the administration of oxidizable organic salts to restore the normal alkalinity.

Several writers have considered the disease to be the result of ptomaine poisoning or a specific infection. Jackson and Harley, from their experience in the Windward expedition, think that scurvy is the result of eating tainted food, the use of lime juice failing to prevent its occurrence while the subjects were on a diet largely composed of tinned and salted meat. Torup had already propounded a similiar theory.

Babes has isolated a micro-organism from cases of scurvy, and has produced a somewhat similar disease by injecting cultures of it into animals ; and Coplans strongly supports the infective theory, as he found that the incidence of the disease in the concentration camps in South Africa varied in the different camps according to the habits of their occupants and the general sanitary arrangements.

If infantile scurvy is considered to be the same disease as the adult form, its lessons must also be considered. It may undoubtedly result from the use of boiled milk, and may be cured by the simple addition of fresh lime or lemon juice, without any other alterations in the food.

This fact seems conclusive evidence against any infective or toxic theory, and according to Dr. Hutchison, is in favour of the acidosis theory, as the process of boiling converts the amorphous soluble citrate of lime which it contains into a crystallizable and less soluble form, some of which is thrown out of solution, and so lost.

Gastro-intestinal symptoms are not very prominent in the majority of cases of uncomplicated scurvy. The sepsis and tenderness in the mouth necessarily render mastication imperfect, and dyspeptic symptoms are not uncommon, though they are rarely severe; a defective quality of food-stuffs will magnify the tendency.

Constipation is the rule, but diarrhœa, which may be of the dysenteric type, may occur. The combination of dysentery and scurvy has not infrequently been observed, and it is necessary to recognize their association.

It is important, in the treatment of scurvy, to limit the infection of the food-stuffs and of the stomach from the buccal cavity; and the food must be fluid or semi-solid as long as mastication is impossible.

The dietary should, if practicable, be composed wholly of fresh foods, and contain a large proportion of vegetables. Lettuce, cabbage, potatoes, yams, onion, cress, are probably the most useful vegetables, and apples, oranges, lemons, limes, the best of the fruits; but the variety seems a matter of relative unimportance, and I have seen good results follow the administration of carrots and vegetable marrow, which were the only fresh vegetables available at the time; and, in another case, of strawberries and cream! Sauerkraut and potatoes are said to be the best form of preserved vegetables; and of the fruit juices those of the lemon and lime. All of these, however, lose their anti-scorbutic properties in time, though they are probably of value for at least two years. Milk, malt and claret are also said to be anti-scorbutic.

In cases where vegetables are not available, fresh animal foods may be utilized, the blood being probably the most important factor. Strong meat soups, raw meat juice, pounded raw meat, etc., may be given.

Any error in the personal or general hygiene should at the same time be corrected. Starvation, overwork, mental depression, insanitary surroundings, may all play their part in the causation of the disease. And on the assumption that the theories of Ralfe and Wright are correct, alkalies should be administered in full doses.

PURPURA

In the majority of cases with purpuric eruptions, the symptoms do not implicate the alimentary tract, and there is no reason to connect it with the origin of the disease; but in a minority such symptoms may obtain, or a gastro-intestinal origin may be suspected.

In purpura hæmorrhagica, for example, hæmorrhage may occur from any part of the tract, epistaxis and intestinal hæmorrhage being the most common, and the loss of blood in either case may be copious and prolonged; and both may occur without any special gastro-intestinal symptoms or with such as are evidently the results of a general and widespread affection.

Cases of the type which are known as Henoch's purpura may, however, be associated with severe gastro-intestinal symptoms, though their relationship is somewhat ill-defined. It occurs mainly among children, and attacks are apt to recur over a period of years. The principal feature is the paroxysmal occurrence of purpuric eruptions with arthritis and abdominal symptoms, the chief of which are colic, which is usually severe, vomiting and diarrhœa, blood being often present in the vomit and the stools. The initial symptoms vary, the abdominal disturbance sometimes preceding the eruption and sometimes succeeding it, while both may arise at the same time. Dr. Osler has emphasized the variety of the cutaneous lesions that may be met with, purpura, erythema, angioneurotic œdema and urticaria, sometimes appearing in successive attacks; and he apparently considers that the symptom-complex is most frequently the result of some general condition, the visceral manifestations being the result of gastro-intestinal lesions comparable to those that occur on the cutaneous surfaces. A hæmorrhagic nephritis is an occasional complication, but one, however, which frequently leads to a fatal termination.

In certain cases purpura is of toxic origin and may follow the administration of such drugs as quinine, belladonna, iodide of potassium, etc., and in another group seems to be associated with hepatic or pancreatic lesions. It thus seems possible that in some cases of Henoch's purpura the abdominal disturbances may be the cause of the illness, and on general grounds the condition of the alimentary tract should be given particular attention.

It is always wise, at the onset of an attack, to ensure that the bowel is emptied of any irritant by the administration of a laxative, unless the diarrhœa has been severe and continued, or hæmorrhage has occurred. Milk is in these cases the most suitable food, and may be diluted or predigested, if necessary.

In the sub-acute cases and in those where intestinal symptoms are absent, the dietary should be bland and unirritating, but the maximum of food that is possible should be given to replace, so far as may be, the loss of blood. The finer farinacea, Benger's and Mellin's foods, eggs, white fish, etc., can often be utilized.

During convalescence a more nourishing diet should be ordered, the items consisting of the "*fresh*" foods, and containing a suitable proportion of the red meats.

The diet between attacks should be carefully supervised, and the ingestion of irritating articles prevented; but it must be acknowledged that the most careful regulation often fails to prevent a recurrence of the attacks, and their origin must be sought elsewhere.

ADDISON'S DISEASE

The symptoms in Addison's disease are mainly of a general kind, the result of the altered nutrition which the loss of the suprarenal function entails, and local disturbances are secondary to the general asthenia.

In the earlier stages abdominal symptoms are rarely experienced, though anorexia may be extreme and persistent; but later on both gastric and intestinal symptoms may be severe, and they are not infrequently the immediate cause of the fatal issue. They often occur in a paroxysmal manner, and may be excited by apparently trivial causes.

Nausea and vomiting may thus be violent and repeated, and interfere greatly with the taking of food; while diarrhœa is apt to occur spontaneously and may follow the use of laxative medicines, or the ingestion of indigestible articles of food.

Care should therefore be taken to prevent the possibility of such disturbances.

The treatment of gastric or intestinal symptoms must be conducted on general lines, and has already been considered in sufficient detail.

THE THYROIDAL DISEASES

It has been known for long that the origin of endemic goitre may be closely associated with a particular water, and that the disease may disappear with the introduction of a fresh and pure supply; but all the attempts to bring it into relation with particular mineral constituents have so far failed, and the available evidence points strongly in favour of some infective agent.

Captain McCarrison's recent observations in Gilgit and Chitral have led him to this conclusion. The disease is endemic in these parts, and villages with the same water supply suffer comparatively from it, while others under similar circumstances, but with a different water supply may be wholly exempt. In a village where goitre was unknown, it became endemic shortly after the arrival of a goitrous family, all the other social conditions remaining unchanged; and its incidence along a common water supply became increased the further the village from the source, presumably as the result of continued contamination from affected communities upstream.

There is, however, evidence that infection may arise in other ways. The use of boiled water may in some cases be a sufficient protective, but in other instances wholly fails, and goitre may, as in an instance narrated by Dr. Mackenzie, be endemic in one village and not in another, though the water supply is common to both. Goitre too seems to attack in particular communities whose social circumstances are poor, and to disappear with the introduction of improved sanitation.

From the individual standpoint goitre is more prevalent among the poorer classes and among persons engaged in agricultural pursuits; and is, for example, practically unknown among the European residents in Gilgit and Chitral. There is there a distinct seasonal prevalence of the disease.

The evidence then is strongly in favour of an infective origin of endemic goitre, and points to the alimentary tract as the probable site of entrance of the parasite. But investigations have so far failed to isolate the active agent, though organisms have been found in the fæces of goitrous patients, and recovery in recent cases follows the administration of thymol.

It is at least possible that exophthalmic goitre may prove to be the result of a similar infection, though evidence is so far almost wholly wanting. Myxœdema and cretinism may also presumably be in some cases associated with an infective etiology, though other causes have been shown to produce functional destruction of the gland.

It seems reasonable, on the evidence available, to make certain that infective agents no longer gain access to the alimentary tract in cases of endemic goitre and Graves' disease; and even in the myxœdemas similar precautions should be observed, though in all probability the damage to the gland is already irretrievable. A pure water supply is the essential factor, and rain water or boiled water should be utilized, not only as a beverage but for culinary and domestic uses, until the infected supply can be replaced. Captain McCarrison's evidence of other possible methods of infection should lead to renewed precautions with regard to the possible contamination of other articles of diet. In all cases removal to non-affected areas is preferable, at any rate for a time.

The appetite in the thyroidal diseases is apt to be defective, and it may be, especially in cretins, perverted. A due supervision of the diet must be maintained in consequence. Alimentary symptoms are, as a rule, absent in cases of goitre and the myxœdemas, though constipation may require attention.

In exophthalmic goitre, however, both gastric and intestinal symptoms may be severe, and may even lead rapidly to death. Attacks of vomiting and diarrhœa occur, sometimes in conjunction, sometimes isolated. Nausea may be intense and vomiting persistent and violent, following the ingestion of everything, whether fluid or solid; epigastric pain is sometimes acute, or, on the other hand, may be absent. The diarrhœa is usually painless, but large loose stools may be passed frequently, and if continued, prostration becomes extreme. The tachycardia becomes exaggerated, the cardiac power fails, and death ensues from cardiac exhaustion. Death may occur within four or five days, but the duration of fatal attacks is usually longer.

In some instances the symptoms follow notable indiscretions in diet, but in others their origin is obscure. Acetonæmia often co-exists, and both acetone and diacetic acid may be recognized in the urine.

The diet in these cases then must be carefully regulated, and the ingestion of irritating food-stuffs prevented. The food should be bland and easily digested, and any minor digestive symptoms should be promptly attended to. Thirst is sometimes extreme, and the constant imbibition of fluids seems at times provocative of such attacks. In cases with acute gastric or intestinal symptoms treatment is rarely of much avail. It should be conducted on the lines already laid down.

DIET IN DISEASES OF THE KIDNEYS

CHAPTER XXII

DIET IN DISEASES OF THE KIDNEYS

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General considerations.—The place of diet in the treatment of affections of the kidney is one of considerable importance inasmuch as so many renal affections run a prolonged and chronic course and many of them are not capable of being very directly influenced by drugs. Further, a large number of renal affections are of **toxic origin** and dependent upon the action of poisons on the renal elements and on the blood vessels, and some of these toxic agents may be consumed as food, and thus diet is of importance not only in the treatment but also in the prevention of renal disease. Again **the composition of the urine** can be profoundly affected by diet and even such a fundamental characteristic as the reaction of the urine can be altered by suitable diet. The part played by changes in the composition of the urine in the production of renal disease is no doubt to some extent uncertain, but at any rate the composition of the urine is a factor of considerable importance in some affections as, for example, calculus disease. It may well be that the production of a calculus is not solely dependent on the amount of the particular calculus forming ingredient present in the urine, but still in all cases this must be a factor of some importance. Thus the formation of a uric acid calculus may perhaps take place when the actual percentage amount of uric acid in the urine is not necessarily high, yet the formation of such a calculus in any given patient may be influenced to some extent by the quantity of uric acid present, and perhaps still more so by the form in which it is present, in other words, the relation of the uric acid to the other salts of the urine, as for example, the phosphates and the chlorides. Modifications in the composition of the urine may therefore affect such a process as the formation of a calculus, not only by increasing or diminishing the amount of the calculus forming ingredient present but also by modifying its chemical relationships with other urinary constituents and especially its solubility.

An **excessive meat diet** may lead to a deposition of uric acid in the urine, not only by increasing the amount of uric acid excreted, owing to the large quantity of purin bases present in the food, but this diet may also bring about a deposition of uric acid as a result of increasing the acidity of the urine, since the meat food will lead to an increase in the acidity of the urine, dependent on an increased excretion of acid phosphate of soda. This illustrates very well the complex effect that may follow a given diet. These alterations in the composition of the urine are produced directly, owing to the presence in the food of certain substances, or owing to certain bodies, e.g. uric acid, being formed as the result of the normal metabolism of the food. Indirect effects, however, are perhaps of greater importance and may also follow the use of certain diets under abnormal conditions. A familiar instance is afforded by the study of gout, there would seem to be but little doubt that gout, at any rate in some individuals, is brought about by a particular diet, and in the gouty an attack of acute gout may be seen to follow certain indiscretions in diet, and it is at any rate possible that gout is associated with and dependent on the production during metabolism of abnormal and toxic substances. These toxins subsequently produce organic disease of various organs and amongst others the kidneys. A better illustration may perhaps be afforded by some instances of oxaluria. A certain degree of oxaluria may be produced in the healthy by the ingestion of certain articles of food, more especially rhubarb,' but there are a number of individuals where large quantities of oxalates are passed in the urine associated with disturbance of the gastric functions and the presence of a certain degree of dilatation of the stomach and fermentation of its contents. In these instances the oxalic acid is not present as such in the food, but is formed as the result of decomposition in the stomach, and the oxaluria results from the absorption of these bodies from the gastro-intestinal tract. The diet in these patients produces oxaluria, although in the healthy it would fail to do so, the urinary effects being entirely dependent on the abnormal decomposition of the food. Such an oxaluria may be treated by dietetic measures, although these must necessarily be somewhat different from those employed where the oxaluria is merely dependent on the ingestion of oxalates as such.

Thus it may be said that **diet may affect the urinary excretion in one of three ways.** It may modify the composition of the urine owing to the direct excretion of substances present in the food as such, as for example, the increased acidity of the urine on a flesh diet dependent on the excretion of increased quantities of acid phosphate of soda. Secondly, the composition of the urine may be modified as the result of the excretion of increased or diminished quantities of the normal products of metabolism of the food constituents as, for example, the increased excretion of urea and of uric acid seen in the flesh diet; and thirdly, the urine may be modified in its composition owing to the presence of substances formed as a result of abnormal metabolism of the food constituents owing to the presence of some pathological condition, e.g. the oxaluria in gastric dilatation.

In employing diet in the treatment of renal disease, it is important to bear in mind that the influence of the diet on the renal lesion may be either direct or indirect.

Renal diseases cannot very well be regarded as a whole from the point of view of their treatment by diet, inasmuch as there are such great **differences in the effects produced by different renal lesions.** Not only is this true with regard to different diseases, but also, to a certain extent, with regard to one and the same disease at different periods of its course. Dropsy is present in some renal diseases, absent in others, and even in the diseases where it is usually present, it may be absent during long periods of time. A diet suitable where dropsy is absent may not be suitable where it is present. The same is true of other phenomena, such as uræmia. Putting aside such conditions as these, renal lesions may be divided into the following groups for the purpose of diet and treatment: First, nephritis in its acute form ; secondly, chronic nephritis ; thirdly, granular kidney ; fourthly, amyloid kidney ; fifthly, calculous disease ; and lastly, other renal affections which may be grouped either with acute or chronic nephritis. There is no great difficulty with reference to most of these groups, but there is some in regard to chronic nephritis, inasmuch as so many different lesions are included under this term. In one variety dropsy may be present, together with other severe symptoms, and the patient may be profoundly ill ; in a second form dropsy may be absent, but albuminuria, with profound disturbance of the general nutrition, and possibly uræmic symptoms may be present ; and lastly, in a third variety the patient may present few or no symptoms other than an albuminuria persistent and prolonged. All these different forms are frequently included under the general term of chronic nephritis, but there is at any rate a profound difference between the third group and the other two, inasmuch as in the former the albuminuria is practically the only marked effect present. It is obvious that all these three categories of cases of chronic nephritis cannot be satisfactorily treated on one uniform plan, but it is really in the third group of cases that the greatest difficulty in determining the course of dietetic or other treatment arises.

In many of these cases of persistent albuminuria the condition is not one of progressive disease, but rather the result of a former attack of nephritis, and such patients often live for many years without suffering from any marked impairment of general health, although doubtless they run considerable risks of contracting fresh attacks of nephritis. This class of case illustrates very well that treatment should not be determined solely by considerations of the state of the urine, or even by the amount of albumin present.

In most renal diseases the **excretory activity of the kidney is impaired** to a greater or less extent, and this is revealed by the small amount of nitrogenous extractives present in the urine, and by the dilute character of the urine with its well-known low specific gravity, so characteristic of chronic renal disease. The imperfect elimination leads to the retention not only of the nitrogenous extractives, but also of the salts of the urine, and it is possible that this retention may be a factor of great importance in determining the occurrence of some of the complications of renal disease, as, for example, dropsy. Too much attention is sometimes paid to the retention of nitrogenous extractives, and but little to that of the retention of the salts. In the dietetic treatment of the disease it may be of greater importance to regulate the ingestion of the saline constituents of the food than to concentrate attention on the cutting down of proteins. In many renal diseases the quantity of water is also considerably diminished, and in some, suppression may occur; but even when the quantity of urinary water is normal or above the normal in amount, the excretory activity of the organ may be greatly impaired, as is shown by the dilute urine that is excreted. This is more especially true of chronic degenerative diseases of the kidney, especially granular kidney and cystic degeneration, and it is also the case in other chronic inflammatory affections where there is a large overgrowth of fibrous tissue.

Another point of considerable importance is the fact that the **excretion is also often extremely slow,** so that substances introduced into the blood stream that normally appear in the urine within a few minutes are not excreted until after the lapse of half an hour, or even longer. This delay in the excretion is often an index of the degree of inefficiency of the excretory mechanism. The deficiency of the urine in solid constituents in chronic renal disease affords clear evidence of imperfect excretory activity, but the problem in the case of the excretion of water is a little more complex, owing to the relationship existing between the production of renal dropsy and the flow of urine. This is also a point of considerable importance in the dietetic treatment of renal disease. Renal dropsy is sometimes looked upon as directly dependent on the deficient excretion of urinary water, but on the other hand there are many who consider that the deficient excretion is the result rather than the cause of the dropsy. It is obvious that the advisability of regulating the amount of fluid in the diet must depend largely upon which of these two views is accepted. The incidence of dropsy in renal disease is always accompanied by a diminution in the quantity of urinary water excreted, and conversely a subsidence of the dropsy is accompanied by an increased urinary flow. Dropsy is however only present in some renal diseases, more especially in some forms of acute and chronic nephritis, but it is not an invariable accompaniment of either of these diseases. Further complete suppression of urine may occur in a considerable number of renal diseases without the development of any dropsy. This is not only true of the suppression accompanying calculous obstruction, but also with the suppression, partial or complete, that is so often seen in the more severe forms of acute nephritis. These facts are strong arguments in favour of the view that the diminution in the flow of urine, so constantly associated with the development of dropsy, is rather a result than the cause of the dropsy. At the same time it must be admitted that, especially in acute nephritis, the state of the circulation in the kidney, and especially in the glomeruli, is not favourable to the elimination of water by the organ, and that it must be undesirable to produce a condition of plethora by the ingestion of large quantities of fluid.

In most renal diseases, but especially **in acute and chronic nephritis, a toxæmic state exists,** and this toxæmia is doubtless in part dependent on the retention of normal products of metabolism which ought to be excreted, but it is possible that, owing to disordered metabolism, other abnormal substances are also present in the blood stream. Just as dropsy does not necessarily occur as the result of complete urinary suppression, so uræmia is not necessarily seen in the same conditions. Complete suppression, occurring as a result of calculous obstruction, or in the rare cases where a single kidney has been excised, or where the circulation has suddenly been arrested as the result of thrombosis in the renal arteries of both kidneys, is not followed by the development of the ordinary type of uræmia that is such a familiar complication of acute and chronic nephritis and of granular and cystic degeneration of the kidneys. It would thus seem that uræmia can scarcely be looked upon as due to the toxic action of some normal constituent of the urine that is retained as the result of deficient renal elimination. It may well be, however, that the cause of uræmia is some toxic substance formed as a result of abnormal metabolism. Inefficient excretion may play a part in the development of uræmia, and a possible hypothesis is that, as the result of such inefficient excretion, an abnormal toxic substance is retained.

The toxæmia of renal disease shows itself not only in the development of uræmia, but also by other manifestations, as, for instance, the well known gastro-enteritis that is so frequently present in these diseases. There is some evidence to show that where the excretory efficiency of the kidney is impaired, excretion of some of the urinary constituents, as, for example, urea, may take place from the gastric and intestinal mucosa and be associated with symptoms of severe vomiting and diarrhœa.

The presence of toxæmia as the result of renal disease must necessarily be a factor of considerable importance in regulating dietetic treatment.

Malnutrition, shown by wasting, anæmia, and frequently the development of a regular cachexia, is the frequent accompaniment of the more serious, and especially the chronic, forms of renal disease. This malnutrition is doubtless in part dependent on mere loss of appetite and on the gastric and intestinal complications that are so often present. But great wasting may be seen as the result of chronic renal disease, and especially, perhaps, as the result of certain forms of chronic nephritis and granular kidney, without the presence of marked vomiting or other gastro-intestinal symptoms. This malnutrition, together with such a phenomenon as pigmentation, which is also not uncommon in chronic renal disease, would also seem to show that these maladies produce in some ill-understood manner grave disturbances of the nutritive processes of the body. The importance of considering these factors in the treatment of the disease, and especially in the dietetic treatment, cannot be overestimated. There is often a tendency to regulate the treatment by considerations based largely, and sometimes entirely, on the state of the urine. Thus the diet may be cut down, owing to a high degree of albuminuria present, and this notwithstanding the fact that the patient's aspect and body weight may show grave impairment of nutrition. Very often much better results are obtained by not concentrating the attention solely on the state of the urine, but rather by directing the treatment, and especially the diet, to remedying if possible the malnutrition.

Albuminuria in greater or less degree is usually present in renal disease, and in some renal lesions the quantity of albumin lost daily is very considerable, and may amount to as much as 40 grms. per diem. In most diseases, however, the loss is much less than this, but still, inasmuch as many of these maladies are of very prolonged duration, there is a considerable wastage of the proteins of the body. That this is the case is shown by the low percentage of protein matter present in the blood of patients suffering from chronic renal disease, even where dropsy is absent, and there is no fallacy owing to the presence of hydræmic plethora.

The large amount of albumin present in the urine has often led to attempts being made to restrict the loss by diet and by medicine. In some instances dietetic treatment, and especially perhaps the administration of a milk diet, is followed by an apparent great diminution in the daily loss. In some instances this diminution is more apparent than real, and is really dependent on an increased flow of urine due to the liquid diet and large quantity of fluid ingested causing a percentage diminution, but the total quantity lost in the twenty-four hours may remain much the same as with a drier and more solid diet.

Albuminuria is a most important means of recognizing the presence and sometimes the variety of renal disease present, but the degree of albuminuria is not a safe guide for dietetic treatment. This is more especially so as in some of the most serious renal diseases, e.g. granular kidney and some forms of chronic nephritis, the albuminuria is slight in amount, and it is even possible for serious and fatal renal disease to be present without any albuminuria; this absence of albumin no doubt is often only temporary, but still this fact may cause very serious errors of diagnosis and of treatment. In most instances the degree of albuminuria is only roughly estimated by the amount of deposit in a given sample, and observations on the twenty-four hours' urine are but rarely undertaken. This is most misleading, as the degree of albuminuria, even in chronic renal disease, may vary within wide limits at different periods of the day, and estimation should always be based on an examination of the twenty-four hours' sample.

Many renal diseases are accompanied by **secondary effects in the cardio-vascular system.** High tension, cardiac hypertrophy and arterial degeneration are frequent accompaniments, especially of chronic nephritis and of granular kidney. High tension may, however, exist without any notable degree of arterial degeneration, and further, the arterial degeneration when present may not be universal in its distribution, thus in some instances though the vessels of the body generally present marked changes characteristic of arterio-sclerosis the cerebral vessels may be relatively healthy. In other cases, on the other hand, they may be profoundly sclerosed.

In determining the treatment of the disease it is important to take into consideration the degree of high tension present and also the presence or absence of marked arterial lesions. Some of the most serious complications of renal disease are dependent on the presence of these lesions. Thus epileptiform seizures of great severity may be due apparently to arterial spasm associated with high tension, and such a serious lesion as cerebral hæmorrhage may owe its origin to the arterial degeneration associated with renal disease.

In regulating the diet in renal disease attention must be directed to all the factors mentioned above, and although the state of the urine must be allowed due weight, the effects of the renal disease on the circulation and on the general state of nutrition must also be considered. The main objects aimed at should be: (1) To diminish the work of the kidney so far as is possible; (2) to maintain the general nutrition and to counteract, if possible, the weakness and wasting present; (3) to regulate, so far as is possible, by diet the arterial tension; (4) to be careful that the diet should not be such as to promote a condition of hydræmic plethora which may not only tend to aggravate any dropsy present, but may also seriously affect the circulation, and especially the heart, owing to the frequent presence of cardiac dilatation in nephritis.

It is clear that in different renal diseases these varying factors are of greater importance in some than in others; thus in calculous disease the main efforts must be directed to modifying the composition of the urine; in acute nephritis the great aim will be to diminish the work of the kidney; in chronic nephritis and in granular kidney attention will often have to be directed mainly to the state of nutrition, the regulation of arterial tension and the amelioration or prevention of dropsy.

It must be borne in mind in all the attempts made to diminish the work of the kidney that a considerable proportion of the nitrogenous extractives of the urine are derived from the breaking down of the tissues of the body and that no limitation in diet will affect the quantity of this portion of the nitrogenous excreta, and that therefore to diminish the diet for long periods of time owing to a deficient excretion of urea may be followed by aggravation of the patient's general weakness. Further, the low percentage of urea in the urine is not entirely dependent on imperfect elimination as a varying proportion of protein matter representing non-metabolised protein is passed out in the urine. Again these patients have often a poor appetite and may suffer from diarrhœa and vomiting and these will also tend to diminish the metabolism of protein and the excretion of nitrogen. The diminution of the protein ingesta is especially indicated in acute renal disease such as acute nephritis, and in this malady there can be no objection to reducing the protein taken to as small an amount as possible or even, in some cases, to withhold it altogether for short periods of time. In chronic nephritis, on the other hand, much care should be taken in determining accurately the significance of the scanty urea excretion that may be present, due weight being attached to the presence of such symptoms as diarrhœa and vomiting, and the degree of albuminuria present and the amount of nitrogen ingested in the form of protein. When all these factors are duly considered it will often be found that although the percentage amount of urea and other extractives is low, the total amount excreted in the twenty-four hours is not such as to imply that there is necessarily any material retention of these substances in the blood stream, since the quantity of urine is often much increased. On the other hand, in severe cases of chronic renal disease and especially in those accompanied with uræmic symptoms there may not only be very considerable retention of these normal nitrogenous extractives, but they may also be present in undue amount in the blood owing to increased production.

The regulation of diet is probably most important of all in cases of chronic disease such as granular kidney where, notwithstanding the appearance of health, the excretory activity of the kidneys may be very seriously impaired. Many of these patients have often been large meat-eaters, and owing to their passing considerable quantities of urine it is often difficult to persuade them that there is any serious renal lesion. In such cases the deficient excretion of urea is a factor of the first importance in regulating the diet since none of the conditions mentioned above, such as diarrhœa, vomiting, or marked albuminuria, are present to minimize the significance of the deficient urea secretion.

Although the proteins are the food constituents on which most stress is laid in regulating the diet of renal disease, **the ingestion of common salt** is also a matter of considerable importance. It would seem to be clearly established that the taking of large quantities of salt may play a very considerable part in the degree of development of dropsy in certain renal diseases, especially chronic nephritis. Where dropsy is present it often increases materially in amount when a diet rich in salt is given. This applies not only to the dropsy of renal disease, but also to that of cardiac affections. Further, it can be shown that in chronic parenchymatous or chronic diffuse nephritis the quantity of sodium chloride present in the urine may sometimes be small, and this is the chronic renal lesion that is most often accompanied by dropsy. On the other hand, in granular kidney the excretion of sodium chloride may be large in amount and some have attributed the increased urinary excretion to this factor. The diminution of salt in the food may lead to the most marked improvement in, or even subsidence of, dropsy in cases where it is present, and very often better results are obtained by treating such cases with a relatively dry salt-free diet than by prescribing a milk diet as is so often done in a routine fashion.

A question of considerable difficulty is that of the **adminis-**

tration of simple fluids. There is much to be said in their favour as flushing agents, more especially in some inflammatory affections of the kidney where the tubules are blocked to a greater or less degree by detritus and products of degeneration, such as casts and blood corpuscles, etc. Water in considerable quantities is often advised as a diuretic. On the other hand, the state of the kidney may be such that the elimination even of water is carried on with great difficulty and the administration of large quantities may lead to the development of a hydræmic plethora that tends to aggravate any dropsy or any cardiac dilatation that may be present.

The importance of **cardiac dilatation** in acute and chronic renal disease is often under-estimated. In acute and subacute nephritis death may result from cardiac dilatation in cases where dropsy is not marked and where the uræmic manifestations are only slight. It is perhaps in this type of case that the most serious risks are run from aggravating the condition of plethora by the administration of excessive quantities of fluid. Cardiac dilatation running a more chronic course is also a very familiar feature in chronic renal disease associated with more or less extensive cardio-vascular degeneration. In these circumstances the regulation of the quantity of fluid ingested may also be of great importance.

ACUTE NEPHRITIS

From the standpoint of treatment two varieties of acute nephritis may be recognized. In the one, dropsy is present in addition to marked changes in the composition of the urine. In the other dropsy is absent and unless uræmia or such complications as secondary inflammations develop, the main phenomena presented are the morbid changes in the urine. Although these two forms of nephritis are closely related, the one does not necessarily pass into the other, nor is the one necessarily a less dangerous malady than the other. In some cases of acute nephritis death may result from the severity of the local lesion without the development of any dropsy whatever, and on the other hand, in the dropsical cases, complete subsidence of all the pathological phenomena may take place in the course of time. In all forms of acute nephritis, however, **the main indication** in dietetic treatment is to **diminish to the utmost the work of the kidney.** Unfortunately, acute nephritis is of very uncertain duration, and hence the diet cannot be restricted to the full extent desirable for any very prolonged period. There is much to be said in favour of cutting off all food for twenty-four to thirty-six hours at the onset of a really acute nephritis unless this complication occurs in the course of some infective disease where the general strength of the patient has already been much diminished, and where it is not desirable therefore to further weaken him. In many cases the restriction to this extreme extent is not difficult owing to the great distaste for food and the presence of considerable nausea and vomiting. Such patients should simply be allowed water in moderate amount during the twenty-four or thirty-six hours during which the food is stopped. The bulk of cases of so-called acute nephritis are not of a sufficiently severe type to require this treatment, which is really mainly indicated in those severe cases of acute nephritis which are ushered in with almost complete suppression or, at any rate, with the secretion of a very scanty highly blood-stained urine. Although the water is beneficial from the point of view of flushing out the kidney and getting rid of the detritus, care must be taken not to administer it in excessive amount, as it is precisely in this form of acute nephritis that the excretion of water by the kidney is most seriously compromised. In cases of acute nephritis where dropsy is present and where usually the suppression of urine is not developed to such a high degree as in the first type of case, there is not the same necessity for cutting off all food. The diminution in the excretion of urine in the dropsical type of case is, in part, dependent on the development of the dropsy, and although no doubt the excretory activity of the kidney is more or less seriously impaired, yet it is not so extensively affected as in the first type of case.

In the **anasarcous variety of acute nephritis** and in the other **less severe cases** of acute nephritis, **the diet** should consist **essentially of milk.** It is desirable, however, not to give this in large quantities as it is essential to maintain the principle of cutting down the work of the kidney to as great an extent as possible. Three pints of milk per diem is probably about the minimum amount required by a normal adult, and even on this quantity it is impossible to maintain normal nutrition for any prolonged period. In acute nephritis, however, far smaller quantities than this may be given, at any rate for a time, as no great harm will result from a temporary cutting down of the diet below the normal quantity required. Hence the diet may be restricted with advantage to one pint or one pint and a half of milk in the twenty-four hours. In many cases there is such distaste for food and so much nausea that there is no advantage in attempting to increase the quantity or the kind of food given; but in others where these symptoms are not marked there can be no harm in giving food-stuffs such as carbo-hydrates and even fats which do not increase to any material extent the work of the kidney. Thus there is much to be said in favour of diluting the milk with barley-water or gruel, or even if the patient desires it allowing bread and butter in small quantities. Better results will be obtained by giving a moderate quantity of milk with the addition of **small quantities of bread** or of **bread and butter** than by increasing simply the quantity of milk. In those cases where dropsy is marked and where there is only diminution in the amount of urine rather than actual suppression some departure from the milk diet may be advisable, and such patients may take larger quantities of bread and butter, or even vegetable food, such as mashed potato, if they have sufficient appetite or desire and taste for such food. Several observers have obtained good results in the treatment of acute nephritis by giving a relatively dry diet of this type than by the indiscriminate administration of milk. Better results still are obtained if **salt is entirely eliminated** from the food. This, however, is difficult as it involves the necessity of special methods of preparation as, for example, production of a salt-free bread and the restriction of salt in the food is perhaps of more importance in the treatment of chronic than in the treatment of acute renal disease.

In all cases where the food given is fluid, as for example, milk and gruel, care should be taken that the total amount of fluid given in the twenty-four hours is not unduly large in cases where there is obvious difficulty in the excretion of water as shown either by the state of the urine, or by the presence of dropsy. **Various fruits** may be given even in acute renal disease, as very often they will give much relief by obviating thirst and by relieving the unpleasant taste in the mouth that is so often associated with the different forms of acute and chronic renal disease. Fruit juices are also of considerable nutritive value, and although many fruits contain diuretic substances it is not probable that these will produce any injurious effect in the small quantities that are likely to be taken in the course of such a malady as acute nephritis. The juice obtained from pine-apples, peaches, grapes, oranges, grape-fruit, are all useful. On the other hand, meat extracts, animal broths, beef-tea, should not be given. The nutritive value of many of these is very low unless they are made in such a fashion as to retain the protein constituents of the flesh, and if this be done there is no class of food-stuff that is more unsuitable for the treatment of acute renal disease. Such extracts are always rich in nitrogenous extractives and salts and as already stated, may contain considerable quantities of protein ; thus they greatly increase the work of the kidney and should on no account be allowed.

Patients often object to milk, more especially on account of the nausea that is such a constant feature in renal disease and further, in many instances, vomiting may also be present. If these symptoms are marked it would probably be advisable to partially digest the milk prior to its administration, and the best results are frequently obtained by pancreatizing a mixture of equal parts of milk and gruel.

Alcohol should not be given in acute renal disease unless there is urgent need for its administration owing to the development of some complication requiring cardiac stimulation.

With the subsidence of a nephritis the diet can be gradually increased in amount and more solid food in the form of bread and butter, bread and milk, milk puddings, can be given.

CHRONIC NEPHRITIS

In the dietetic treatment of chronic nephritis we meet with the greatest difficulties because many factors have to be taken into consideration. In the first place the presence or absence of complications such as dropsy, uræmia, and the more serious effects produced by high tension. Secondly, the degree of impairment of the general nutrition as shown by wasting, cachexia, and the presence of anæmia, is a point of the greatest importance. Lastly, the variety of the renal affection that is present and the state of the urine, both as regards quantity, specific gravity, and to some extent the mere amount of albumin present must also receive attention.

The presence of certain **complications such as uræmia** and **secondary inflammations** is an indication for a diet similar to that ordered in acute nephritis except that in long-standing cases it is clearly impossible to maintain such a low diet as that ordered in acute nephritis for prolonged periods of time. Still little can be given except milk, gruel, bread, fruit, and possibly in some instances, milk puddings. Animal broths and meat extracts are probably still more inadvisable in this type of case than in acute nephritis. In cases where uræmia, and more especially uræmia of a gastro-intestinal type, is present, the food will probably have to be artificially digested and given in very small quantities. The treatment of these cases, however, is necessarily very unsatisfactory, inasmuch as where uræmia supervenes in chronic renal disease the malady is usually far advanced.

The dietetic treatment of **dropsy** is more successful than that of the other complications of renal disease just alluded to. Dropsy is seen in chronic nephritis in two main forms. Thus it is a frequent accompaniment of chronic tubular or chronic diffuse nephritis and then has the ordinary characteristics of renal dropsy. In cases of contracted kidney the dropsy is sometimes of a slightly different type and resembles that seen in cardiac disease. From the point of view of diet no distinction need be made between these two varieties. The usual diet ordered for these patients is a **milk diet,** and not uncommonly they are restricted entirely to milk, which is given in considerable quantities of from 3 to 5 pints a day. There are many arguments in support of such a diet. Thus it is readily digestible in cases where there is no natural disinclination to milk, and in addition many of the constituents of milk have a distinct diuretic action and the flow of urine under such a diet even in advanced chronic renal disease is often materially increased. The percentage amount of albumin in the urine falls and it cannot be denied that many of the symptoms of the disease undergo amelioration and cases are on record where after prolonged administration of such a diet there has been notable improvement. On the other hand there are certain practical and theoretical objections to such a diet being ordered as a matter of routine in all cases of chronic renal disease accompanied by dropsy. In the first place, many patients are very intolerant and dislike an exclusive milk diet, and this perhaps is especially the case in those instances of chronic renal disease where there may be much nausea and anorexia and dislike to all food. Again, it is difficult to maintain the body-weight and the normal nutrition in an adult on a milk diet for a prolonged period. Such food is unduly rich in protein and contains insufficient carbo-hydrate and fatty materials and theoretically an excessive protein diet is unsuitable for chronic renal disease. Further, where large quantities of milk are taken there must be considerable risk of producing hydræmic plethora and thus there may be a danger of aggravating any existing dropsy. All these objections are of considerable force and there is another dependent on the richness of milk in saline ingredients and thus there is the further danger of aggravating the dropsy owing to the retention of sodium chloride if the elimination of this by the kidneys is deficient. The risk of milk containing an excess of protein matter loses some of its force, owing to the loss of albumin, and hence the waste of protein matter that is such a constant accompaniment of chronic nephritis accompanied with dropsy. Although some patients with chronic renal disease improve under milk diet there can be no question that a very large number do not and that notwithstanding the increase in the flow of urine, and the diminution in the percentage amount of albumin present, there is no real improvement when the patient is tested either by his own feelings or by the state of the general nutrition. As already mentioned above the diminution in the albuminuria is often more apparent than real owing to the increased flow of urine resulting from the fluid ingested. This fallacy of observation is one of the reasons why attention should be directed to the general condition of the patient rather than to the mere analysis of the urine alone. It is probable that an exclusive milk diet is mainly of service in chronic nephritis where complications are present or where there is reason to think that sub-acute nephritis is superadded to the chronic disease.

Where no complications are present it is probable that better results can be attained by a **modified diet** containing larger quantities of carbo-hydrates and for this purpose farinaceous foods prepared with milk may be given with advantage such as bread, corn-flour, rice, etc.

The question of more fundamental importance, however, is whether better results cannot be obtained in cases where dropsy is present by the administration of a **drier food** and also by **restriction in the ingestion of sodium chloride.** Some striking results have been obtained, especially in France, in the treatment of chronic renal disease by the administration of a diet containing considerable quantities of vegetables prepared and cooked and taken without salt. In many such cases there is really no objection to the giving of eggs, although there is much prejudice against this article of diet in renal disease. Egg albumen is readily digestible and very large quantities must be taken in order to produce any irritating effect on the kidney, and the albuminuria that results from the indiscriminate administration of raw eggs is an albuminuria apparently produced by a toxic action on the renal structures. It may therefore be advisable in chronic nephritis accompanied by dropsy to replace an exclusive milk diet by one consisting of bread and milk, eggs, arrowroot, rice milk, and vegetables plainly cooked without salt. In some instances milk may be omitted altogether and the diet consist of farinaceous food-stuffs, vegetables and one or two eggs in the twenty-four hours.

In a considerable number of cases, however, even where dropsy is present, the diet may be with advantage more liberal than this, and small quantities of poultry, meat and fish given. The articles selected should be chosen from the point of view especially of their digestibility, and owing to a large part played by psychical influences in the digestive process much advantage may be gained by consulting the patient's wishes and tastes.

In selecting **meat in cases of renal disease** attention should be directed rather to the digestibility of the different varieties than to questions of whether the meat is red or white, thus mutton is preferable to beef on account of its greater digestibility. Further it is probably more important to regulate the quantity than to lay undue stress on the kind, thus patients may derive more benefit from small quantities of readily digestible red meat than from larger quantities of white meat. In the past too great stress has apparently been laid on the distinction between red and white meats. It must be also remembered that fish, although very useful in these cases as in other diseases where the digestive processes are impaired, is as a matter of fact singularly rich in nitrogenous extractives, and thus more work may be thrown on the kidneys with a diet containing large quantities of fish than with a diet consisting of a moderate quantity of meat and a considerable amount of vegetable. It is especially in cases of chronic renal disease where a high degree of anæmia is present and where little or no improvement has taken place on a milk diet that an ordinary mixed diet with moderate quantities of red meat produces the best results. Although in these cases it is advisable to order meat, the amount given should be strictly regulated and it is probably always advisable to limit the meat to once a day at the outside. Further, the practitioner must be guided by the results and should pay especial attention to the general condition of the patient as gauged by the colour of the mucous membranes and the body-weight as well as by the state of the urine. In estimating the body-weight, however, care must be taken so far as is possible to avoid the fallacies dependent on the variations in the amount of dropsy. Both the incidence and the subsidence of dropsy produce often great and sudden changes in the body-weight. Thus a sudden increase in the body-weight is much more likely to be dependent on an increase in dropsy than on an improvement in the nutrition, and similarly a sudden loss of body-weight may often be due to subsidence of the dropsy. The fact that the fluctuations in the body-weight are dependent on changes in the amount of dropsy may usually be ascertained by observing the increase or diminution in the flow of urine and also by the fact that these variations in the body-weight are much more sudden and marked than those due to an improvement in the patient's nutrition. Although a meat diet may be and often is most suitable for certain cases of chronic renal disease, there are certain forms of meat food that are highly objectionable in such cases. First and foremost great care should be taken that all meat should be absolutely fresh, as there is little doubt that very severe symptoms of a gastro-intestinal type may result from the consumption of tainted foods. An attack of gastro-enteritis which in a healthy person may give rise to only temporary discomfort may in chronic renal disease be not only very serious, but may even cause death. Gastro-enteritis would seem to be very easily produced in cases of chronic renal disease, and this complication may lead to the development of uræmia. Preserved and especially smoked, concentrated, and salted meat foods are also unsuitable in these cases inasmuch as such foods are necessarily very rich in protein constituents and thus throw an undue strain on the excretory activities of the kidneys which are impaired to a greater or less degree. It has long been recognized that smoked and salted foods are unsuitable and the observations on the influence of sodium chloride on the production of dropsy afford an explanation of one of the injurious effects that such articles of diet may have. For these reasons smoked ham, tongue, and preserved meats and fish are undesirable. Twice cooked food is also unsuitable, mainly owing to its relative indigestibility and also probably owing to the fact that such food may have undergone decomposition. Meat extracts, meat essences, soups and broths are also unsuitable, the meat extracts and essences owing to their richness in extractives and their concentrated character, meat soups and animal broths are also not advisable since their nutritive value is low and they tend to produce looseness of the bowels or even actual diarrhœa. A diet containing a moderate or small quantity of fresh meat or poultry with occasionally fish with plenty of vegetables and fruit, together with milk puddings and farinaceous food, is most suitable for many forms of chronic Bright's disease. Even in these cases the bulk of the food should undoubtedly consist of vegetables and farinaceous articles of diet provided the patient's digestion is such that he can readily deal with it.

Where there is much wasting and the general nutrition much impaired, vegetables should be if possible cooked with butter in what is often called "the French fashion."

In that form of chronic Bright's disease **where dropsy is absent** it is not necessary to restrict the amount of salt in the food as is so advisable in the dropsical cases, but otherwise the dietary should be on the same general lines and inasmuch as these patients are particularly prone to suffer from uræmia care should be taken that the diet is not too liberal in proteins. Further, many of these patients suffer from the effects of high tension and marked arterial degeneration, and there can be no question that a diet rich in animal food is extremely prone to increase if not to produce high tension. In such cases the animal food in the dietary should be limited as much as possible with due regard to the degree of anæmia present. Many patients with chronic renal disease have been accustomed, as it is said, to live well and to take during long years a highly nitrogenous diet. If the diet be too suddenly restricted to milk foods they experience a great loss of strength and of energy, and although it is imperative in cases where marked high tension is present, and where the other symptoms of chronic renal disease may be slight, to limit the diet, this must be done cautiously, and in many of these cases it is advisable to allow butcher's meat either once daily or two or three times a week. If symptoms of uræmia develop or if symptoms resulting from high tension become marked, the diet must be still further limited and probably in these cases it is wise to greatly diminish solid foods and to order milk in small quantities, milk puddings, stewed fruit and farinaceous foods generally. Such patients often run great, if not greater, risks from the effects of high tension than from any of the other complications associated with renal lesions.

Alcohol is probably inadvisable in all forms of chronic Bright's disease, at any rate as a routine. It may be necessary from time to time to order small quantities as a cardiac stimulant, possibly sometimes as a soporific, and in a few instances it may be necessary for the patients to take small quantities with their meals, more especially in the chronic renal disease of the elderly. It is often difficult to carry out these principles inasmuch as many of these patients have been accustomed to take alcohol, often in large quantities and for long periods, but it is very harmful in chronic renal disease for many reasons, and more especially from the effects of alcohol as an excitant of the circulation when it is remembered what extensive cardio-vascular lesions are so often present in chronic renal disease. If alcohol be given at all it must be freely diluted, and this is probably more important than the particular form of alcohol prescribed. The evil effects liable to be produced by alcoholic stimulants in this disease, and for the matter of that in many others, are probably mainly dependent on the actual amount of alcohol in the particular drink consumed. The light wines are more advantageous than the heavier ones for the reason that they contain a less percentage of alcohol. For many years gin has been held in repute as a suitable form of alcohol in renal disease; this is very doubtful and probably owes its origin to its diuretic action which it shares in common with other alcoholic drinks, although perhaps to a somewhat greater extent. If spirits are taken at all they should be freely diluted, and it is essential that only small quantities should be given.

The use of **tea and coffee** in chronic renal disease is often forbidden owing to the diuretic action of the active principles of tea and coffee. This is done on the general principles that it is inadvisable to stimulate a damaged organ. On the other hand it must be remembered that in chronic renal disease the lesions in the kidney are not uniformly distributed and that not uncommonly considerable areas of the kidney present comparatively little pathological change. Further, the use of diuretics, especially citrate of caffein, is sometimes followed by very beneficial results in cases where dropsy is marked. Both tea and coffee have a very considerable diuretic action and there does not seem really to be any valid objection to their use in cases of chronic renal disease in the absence of gastro-intestinal or uræmic complications. Certainly the mere presence of dropsy should not be regarded as an objection. Coffee is perhaps superior to tea not only from the fact that more milk is taken with it, but also since it produces a less injurious action on the stomach.

There is a variety of **chronic nephritis** that is **associated with syphilis** and this form of the disease frequently does not require such rigid dieting as the more ordinary forms of chronic Bright's disease. In the syphilitic variety one of the main characteristics is an intense albuminuria and such patients may present few symptoms of illness beyond general weakness. In some instances even this is not well marked, and were it not for the intense albuminuria the condition might escape observation. This albuminuria is not only very marked in amount, but is often of prolonged duration lasting many months. In some instances dropsy and the other accompaniments of renal disease may be present, and where this is the case the diet should be similar to that ordered in other forms of chronic nephritis. In the large group of cases where the sole manifestation is an intense albuminuria with no signs of uræmia, no dropsy, and no obvious cardio-vascular involvement the less strict diet is more advisable and such patients improve more rapidly if they are allowed a mixed diet containing moderate quantities of meat.

The **nephritis of pregnancy** unless complications are present also scarcely requires a very rigid diet as here also the course of the disease is often favourable so soon as delivery takes place or the uterus is emptied.

Where the nephritis of pregnancy is of a severe type and accompanied by eclamptic or uræmic phenomena the diet must be similar to that suitable for acute and sub-acute nephritis.

The last group of cases that merits consideration is that in which an **albuminuria persists after an attack of nephritis.** In many of these cases there are no marked symptoms of renal disease beyond the presence of a persistent albuminuria and casts. Many of these cases are looked upon as examples of chronic nephritis, and no doubt this is correct if the words are used in the sense that an organic lesion of the kidney is present. Such a lesion, however, is not necessarily progressive, and such patients may live for years, sometimes even forty years, excreting all the time a more or less highly albuminous urine, but without presenting any persistent dropsy or any cardio-vascular degeneration, or any uræmic symptoms. In the absence of these complications, no beneficial results will be obtained by putting these patients on a restricted and rigid diet with the idea of thereby diminishing the albuminuria. In fact, much harm may be done by lowering their general health by a milk diet insisted on for too prolonged a time. Doubtless the efficiency of the kidney in these cases is somewhat impaired, but the albuminuria may be regarded rather as produced by a lesion that is the result of the attack of the nephritis, than as the result of a slowly progressive and destructive kidney lesion. There is no class of cases of renal disease where it is more important to diet the patient on general considerations, and such patients should be ordered a simple mixed diet with plenty of vegetables, fruit, and a moderate quantity of fish and meat.

GRANULAR KIDNEY

Diet is of great importance not only in the treatment of granular kidney, but also much may be done by suitable food to prevent the development of this disease in those prone to it. Further, there can be little doubt that severe as the affection is, life may be prolonged by a suitable dietary in these cases.

Granular kidney affords one of the best illustrations of the principle that the diet should be based not so much on the condition of the urine as on the general state of the patient. Dietetic treatment is peculiarly important in this variety of chronic renal disease owing to the fact that the malady is prone to occur in those who have been accustomed to indulge in the pleasures of the table. Further, granular kidney is peculiarly associated with arterio-sclerosis and cardio-vascular degeneration, and arterial disease would also seem to have a very similar etiology.

that is to say, arterio-sclerosis and granular kidney may have a common factor in their etiology, although the one is not a necessary and invariable accompaniment of the other.

From the point of view of treatment several different varieties of granular kidney may be recognized. In some cases the patients present obvious renal symptoms similar to those seen in chronic nephritis, but a large proportion of cases come under observation with other symptoms dependent upon the degree of involvement of the cardio-vascular system, or even perhaps with symptoms due to malnutrition.

From the point of view of treatment by diet, perhaps the most important group is that where, with the appearance of health, the occurrence of some symptom as, for example, dyspnœa on exertion, has led to the discovery of the underlying disease. In some cases the disease is discovered purely accidentally as a result, it may be, of a routine examination for life insurance, when the patient has not developed any marked symptoms of ill-health. In these cases, also, much benefit may result from the mode of life being altered and a suitable diet ordered.

In the cases where marked renal symptoms are present and where the patient is more or less seriously ill, the dietetic treatment should be similar to that ordered in chronic or sub-acute nephritis, the degree of restriction depending on the presence or absence of toxic symptoms, gastro-intestinal disturbance, etc.

The **dropsy of the so-called cardiac type** that is apt to arise in granular kidney, should be treated on the same lines as renal dropsy. There is some risk in cases of granular kidney associated with dropsy of the patient taking or being ordered an excessive quantity of fluid, owing to the large quantities of urine which may be excreted in this disease. The patient often has an exaggerated idea of his renal efficiency, and it must be remembered that although large quantities of water may be excreted, the urine is very poor in solids, and the excretory activity of the kidneys is often notably diminished. It is inadvisable to order these patients, especially if dropsy is present, large quantities of fluid food, as there can be little doubt that hydræmic plethora is thereby increased and better results are often obtained by giving a semi-solid, and therefore, drier food and an allowance of enough fluid to check thirst. No useful purpose is served by undue restriction of the fluids ingested, as dropsy cannot be treated successfully on these lines. In the ordinary case of granular kidney with secondary cardio-vascular changes and where the patient seeks advice, probably owing to the development of cardiac symptoms, and yet where he is not obviously ill, the two main principles of dieting are in the first place to cut down the amount of food, and secondly, to diminish as much as possible the proteins without impairment to the general nutrition.

Granular kidney is a malady especially of the latter half of life, and very often sufferers from it have not with advancing years diminished their intake of food, and they remain large eaters. Hence, very strikingly beneficial results can often be obtained by the mere diminution in the quantity of food.

The amount of fluid consumed requires to be somewhat regulated, but it is difficult to lay down rigid rules with reference to this, as on the one hand it is undesirable to produce hydræmic plethora owing to the high tension which is so often present, and on the other hand, it is advantageous, especially in gouty cases, to give sufficient fluid to procure adequate flushing of the kidneys.

The diminution in the quantity, and especially in the quality, of nitrogenous food taken, the alteration in the character of the food, and especially the substitution, so far as is possible, of vegetable and carbo-hydrate food for the highly nitrogenous animal food, and, thirdly, the judicious administration of diluents are the main principles in the regulation of the diet in these cases.

Although it is essential to cut down **the nitrogenous articles of diet,** especially meat, it is probably inadvisable to exclude meat altogether, unless complications are present. If the general health be lowered by too rigid and too low a diet there is some risk of producing cardiac dilation and what is usually spoken of as failure of compensation. Many of these patients complain bitterly of the feeling of illness and general weakness produced by too low a diet. It has been the custom to advise, especially in this class of case, replacement of red meat by white meat. It is doubtful, however, whether this is really followed by striking benefit, except in so far as poultry may be more digestible in some instances than ordinary red meat. The main thing to insist on is the regulation of the quantity of meat eaten, and although white meats are poorer in protein than red meat, yet sometimes if the patient be given a free hand, large quantities of white meat may be taken under the idea that it is relatively harmless, whereas better results would be obtained by smaller quantities of ordinary meat of different kinds being allowed. Concentrated meats and preserved, smoked, and salted meats should certainly be forbidden. In the opinion of the writer the best results are obtained by ordering a mixed diet carefully restricted in quantity, and the patient's appetite should be satisfied so far as possible, with vegetables and farinaceous articles of diet. Meat essences, strong animal soups, should certainly be forbidden and replaced by vegetable soups. The **quantity of fluid** ingested should also be regulated, and especially the taking of large quantities of fluid at any one time. There is considerable risk of increasing the plethora and the blood tension by the sudden ingestion of large quantities of fluid. At the same time it must be remembered that the tension of these patients is necessarily above the normal, and that if it be reduced too suddenly to the normal, serious effects may follow. In other words, regard should be had rather to the condition of the individual patient than to theoretical considerations as to what is the normal pressure, and it must be remembered that such patients have become to some degree accustomed to an abnormally high blood pressure.

Patients with granular kidney not only run dangers from sudden increase of the pressure in the vessels, but it is almost as dangerous for the pressure to undergo sudden diminution. The one effect may be brought about by a too highly stimulating nitrogenous diet with the too frequent ingestion of fluid, and the other danger may result from a too rigid limitation of the diet. It is for these reasons that the diet and the administration of fluids should be regulated to a great extent by the signs and symptoms presented by the patient rather than by any arbitrary rule dependent on the exact height of blood pressure as measured in millimetres of mercury.

Stimulants and condiments of all kinds are inadvisable in these cases, partly on account of their action on the vascular system and partly on account of the very frequent co-existence of gastric and hepatic disorders in such patients. There is not, however, the same objection to the taking of salt that exists in cases of chronic nephritis. On the other hand, where the granular kidney is associated with the gouty state, there may be some objection to the taking of large quantities of sodium chloride in the food, as it would seem that this ingredient has some influence on the deposition of urates, and therefore on the production of the gouty paroxysm. Proposals have been made from time to time to replace sodium chloride in the food by salt prepared from vegetables and especially from spinach, in other words, to replace the base sodium by potash (*see* GOUT).

Inasmuch as the excretory activity of the kidney is more or less seriously impaired in cases of granular kidney, it is most important for these patients to avoid all highly-flavoured and elaborately cooked food.

AMYLOID KIDNEY

Amyloid degeneration of the kidneys is not such a common lesion as it used to be, owing to the improvement in the treatment of septic cases. Still, from time to time amyloid disease is still found associated either with phthisis or as a result of long-continued suppuration. There is a considerable clinical resemblance between these cases and those of chronic Bright's disease, and even of granular kidney, but the dietetic treatment of amyloid disease of the kidney is quite different to that of either of these other lesions, and hence it is important that an accurate diagnosis should be made. This is more especially necessary, inasmuch as in cases of phthisis, for instance, both amyloid disease of the kidney and nephritis may exist as complications. In amyloid degeneration the excretory functions of the organ are not compromised to the same serious extent that they are in nephritis, unless the amyloid disease is very far advanced or, as not infrequently happens, the two lesions are co-existent in the same kidney.

One of the most striking effects produced by amyloid disease is albuminuria, and the daily loss of albumin may be very considerable. In some instances, however, the type of urine excreted is more like that seen in granular kidney, being abundant and dilute, and containing but a trace of albumin.

In amyloid disease, as a rule, the renal lesion should not materially influence the dietetic treatment, in other words, the diet ordered should be that suitable for the underlying disease, and no undue stress should be laid on the presence of the renal complication. Much harm may be done by restricting the diet owing to the existence of albuminuria, with the mistaken idea that the diet suitable is similar to that ordered in other forms of chronic kidney disease. It is quite hopeless to attempt to restrict the albuminuria by dietetic measures ; both in nephritis and in amyloid kidney a solid diet, containing considerable quantities of meat, may not materially increase the daily loss of albumin, and inasmuch as the underlying disease associated with amyloid degeneration is usually one where there is very great malnutrition, it is obvious that the diet should not be restricted unless there is very urgent necessity, such as the development of uræmic symptoms, or the occurrence of marked renal dropsy ; the former is a more important indication for dietetic restriction than the latter.

Thus cases where albuminuria results from amyloid disease should be treated quite differently to any other renal lesion accompanied by albuminuria, since a liberal diet in no way restricted is probably the most suitable, and hence the patient's tastes and inclinations can be allowed far greater play than in other affections. Again, there is not the same objection to the use of stimulants in amyloid disease, and they may be ordered where it is considered advisable either from a point of view of the general weakness, or where it is thought advisable to give them from the point of view of aiding digestion or increasing appetite.

FUNCTIONAL ALBUMINURIA

Various types of functional albuminuria have been recognized in the past and attributed to different causes, such as exertion, cold bathing, dietetic causes, and the most important of all, that dependent on the assumption of the erect posture, also called the postural or orthostatic variety. Of late years more importance has been attributed to posture as a cause than to diet, and certainly in most cases of functional albuminuria, and especially in those with well-marked postural characteristics, diet has little or no effect in influencing the degree of albuminuria. In postural cases albuminuria disappears when the patient is put in the recumbent posture even when the diet is not restricted, and such albuminuria may disappear within half an hour of the assumption of the recumbent posture. On the other hand, certain articles of diet if taken in great abundance, more especially eggs in a raw state, may give rise to albuminuria, and hence it is impossible, perhaps, to exclude dietetic causes as an occasional cause of some varieties of functional albuminuria ; nevertheless, diet is not an important cause of the common form of functional or postural albuminuria seen in adolescence. Further, it must be remembered that some constituents of the urine present in abnormal quantity may apparently irritate the kidneys and lead to slight albuminuria ; thus traces of albumin may be found associated with oxaluria and excess of uric acid, or the excretion of urates in an abnormal form, as, for instance, the spicular crystals of acid ammonium urate. Albuminuria dependent on these causes may require dietetic treatment to restrict the output of oxalates or of uric acid, but in the ordinary cases of functional albuminuria little benefit is to be expected from dietetic measures, and certainly the low diet suitable for certain forms of nephritis is quite inapplicable to such cases.

The principles of diet in **other renal affections,** such as **cystic kidney, tuberculous disease, pyelo-nephritis** are much the same as those applicable to nephritis, but in some of these conditions, especially where pyelitis is present, attention should be directed to the reaction of the urine, as much of the discomfort produced by frequent micturition may be relieved by ordering a diet rich in vegetable matter so as to render the urine less acid. In most of these other renal affections, the general condition of the patient should be an important factor in determining the diet. Thus in tuberculous kidney, it may be far more important to diet the patient from the general point of view of tuberculosis rather than from the point of view of the urinary changes. In such a malady, although the urine may contain considerable quantities of pus and albumin, yet large areas of renal substance may exist in a more or less healthy condition, and the renal efficiency of the patient may not be seriously impaired, and thus there may be no real necessity for limiting the quantity of food taken. Similarly in cases of cystic kidney, although the urine excreted may be dilute, still in many cases, a considerable amount of healthy renal substance is still present. On the other hand, in some cases of cystic kidney the renal tissue between the cysts has become fibroid, and such patients present signs and symptoms similar to those of granular kidney, thickening of the vessels, cardiac hypertrophy, with high tension being also present. When this is the case dietetic treatment similar to that suitable for granular kidney should be ordered, and probably in all cases of cystic kidney, owing to the dilute character of the urine excreted, it is wise to limit the nitrogenous ingesta to some degree.

CALCULOUS AFFECTIONS

There are probably at least three factors concerned in the formation of calculi. In the first place, the composition of the food must play a part of some importance, but in addition to this two other factors influence the formation of calculi. First, the amount of the particular calculus forming ingredient in the urine and its chemical relationship with other urinary constituents, and secondly, the presence of some inflammatory affection, sometimes very slight in amount, in the renal pelvis. The formation of a calculus does not depend solely on the mere amount of uric acid or oxalic acid present in the urine. It is well known, for example, that urines that deposit uric acid are very often relatively dilute, and that, on the other hand, urines containing a large percentage of uric acid frequently only deposit urates owing to the excess of other urinary salts present. Thus the formation of the uric acid calculus cannot be correlated simply with the amount of uric acid present in the urine. Still the amount may influence the formation of the calculus to some degree, and hence the regulation by diet of the amount excreted so far as possible becomes important.

The part played by slight pyelitis in the production of calculi is probably of considerable importance, since the formation of a calculus may often depend on an irregular mode of cystallization, such as the formation, for example, of a large crystal under the influence of the presence of some colloid material such as blood, pus, or albumin in the urine. Doubtless the pyelitis may sometimes arise from the action of micro-organisms, and although pyelitis cannot be controlled purely by dietetic measures, yet it can be influenced to some extent by modifying the composition of the urine, especially as regards its acidity.

Where it is desirable to modify the reaction of the urine for prolonged periods, dietetic measures are more suitable than the mere administration of drugs.

Alteration in the reaction of the urine may also be of importance in influencing the formation of calculi, inasmuch as highly acid urines are more prone to deposit uric acid, for instance, than less acid urines. Although the excretion of uric acid in the urine cannot be prevented by any system of dieting, since uric acid is a product of the metabolism of the tissues and is excreted during starvation, yet the deposition of uric acid in the urine either in the form of gravel or calculi may be materially influenced by dietetic measures that act, not only by restricting the output of uric acid, but also by altering the reaction of the urine. Attention is often far too much concentrated on the quantity of uric acid in the urine, rather than on the conditions leading to its deposition.

In the case of deposition of uric acid, diet then may influence the process in at least two ways, by affecting the quantity of uric acid present, and secondly, by affecting the reaction of the urine and so either increasing or diminishing the rapidity of the deposition of uric acid, and, as already pointed out, the latter process may be the more important of the two. In the case of the deposition of oxalate of lime the determining conditions are somewhat different, inasmuch as the great bulk of the oxalic acid excreted in the urine in the form of oxalates is derived solely from the food or from products of the decomposition of the food in the alimentary canal. It is probable that at the most only traces of oxalic acid are formed during the metabolism of the tissues, and thus the amount of oxalates in the urine can be affected far more by diet than is the case with uric acid. Approximately one half of the uric acid excreted is of endogenous origin, i.e. produced by the metabolism of the tissues. The formation of calculi containing oxalates depends, however, on other factors than the mere quantity of oxalic acid excreted, since the essence of the process lies in the formation of the relatively insoluble oxalate of lime in greater or less abundance instead of the excretion of soluble oxalates. Certain articles of diet, especially rhubarb and tomatoes, contain considerable quantities of oxalates, and it is not unusual for oxaluria, due to the ingestion of considerable quantities of these substances, to give rise to symptoms such as pain and hæmaturia. Oxalates, however, may be formed in abundance in the stomach, especially in cases of dilatation of the stomach, and in other conditions where the secretion of hydrochloric acid is deficient and fermentation and decomposition of the gastric contents takes place. This diet may give rise to oxaluria either directly owing to the presence of considerable quantities of oxalates actually in the substance ingested, or indirectly owing to abnormal decomposition taking place as a result of fermentation of the gastric contents.

The regulation of the diet in cases of calculous disease is more important from the point of view of prevention than of cure. No dietetic measures can affect a stone already formed, but it is probable that careful regulation of the diet may prevent the formation of subsequent stones where one has been passed or removed.

Uric acid calculi.—The uric acid present in the urine is, as mentioned above, of twofold origin, partly derived from the metabolism of the tissues endogenous and part derived from the decomposition of the foods exogenous. The former quantity would seem to vary in amount in different individuals, but to be constant for the same individual and to be uninfluenced by diet. The exogenous moiety, on the other hand, can be profoundly influenced by diet. Formerly it was thought that the quantity of uric acid was directly dependent on the amount of the nitrogenous ingesta, in the same manner that urea is, and that a relationship existed between the quantity of urea and the quantity of uric acid excreted. It is now recognized that the uric acid of exogenous origin is derived from certain protein constituents of the food, but not from all; in other words, that it is a disintegration product of the purin bases such as xanthin, hypoxanthin, etc. These purin bases are not present in equal amount in all varieties of protein food. They are, however, especially abundant in certain glands, as, for instance, the thymus and the pancreas, and to a considerable but less degree in ordinary muscle or flesh. Thus a meat diet may greatly increase the excretion of uric acid, not simply because it is rich in protein, but because it contains considerable quantities of purin bases. On the other hand, a diet of milk or eggs, although it may contain an equal amount of protein matter will not yield a corresponding excretion of uric acid, as such a diet is poor in purin bases. Vegetable diet may also, although containing an equivalent quantity of protein matter, fail to yield any notable uric acid excretion because it is poor in purin bases. The uric acid excretion may thus be considerably cut down, by giving a diet in which purin bases are scanty, and yet such a diet may contain considerable quantities of protein.

In the treatment of the uric acid diathesis, whether giving rise to gout or to gravel and stone, it is a point of great practical importance that the kind of protein matter in the food should be regulated and that attention should not be concentrated merely on the amount. Milk, eggs, cheese, bread, rice and vegetables generally, and fruit, form the main ingredients of such diet, and the quantity of meat should be reduced to a minimum. In this way the uric acid excretion may be cut down to a very considerable extent. It must, however, be remembered that the deposition of uric acid in the urine does not depend solely on the percentage amount present, but also very largely on the chemical relationships determining the formation in which the uric acid is excreted, and that in order for it to remain in the urine in a state of solution the reaction of the urine must not be unduly acid, and further, salts must be present in abundance to provide the necessary bases to combine and form biurates. A diet rich in vegetables is peculiarly useful in the treatment of uric acid gravel, inasmuch as vegetables are rich in alkaline salts, especially potash salts. With a liberal diet of vegetables, the reaction of the urine can be rendered far less acid or even neutral, and the deposition of uric acid greatly hindered. In cases of gravel it is advisable for the patient to drink large quantities of water in order to flush out the kidneys as much as possible. At the same time this water should be taken at other times than with the meals, inasmuch as it is not advisable for a dilute urine to be passed at a time when the products of metabolism have to be excreted. The free ingestion of water is also desirable in the treatment of pyelitis, and pyelitis, especially in its slighter forms, may play a great part in determining the production of a stone.

Oxaluria.—In the dietetic treatment of oxaluria, care must be taken not to admit in the dietary food containing an abundance of oxalates, and the diet should be regulated from the point of view of treating any gastric disturbance that is present, and all articles of food liable to undergo decomposition in the stomach should be forbidden. Further, it is essential, as in the treatment of many other gastric disorders, that the food should be given in small quantities, as the stomach is so often dilated. Oxalic acid is in some respects chemically allied to uric acid, and thus may owe its origin to abnormal decomposition of protein.

Care should be taken in the dietary that the food ordered is of the simplest and freshest, and inasmuch as the gastric digestion is often inefficient, it is desirable to limit the ingestion of fluid within meals, since large quantities of fluid may seriously weaken the action of the digestive juices.

DIET IN DISEASES OF THE NERVOUS SYSTEM

CHAPTER XXIII

DIET IN DISEASES OF THE NERVOUS SYSTEM

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NERVOUS diseases are best divided, for the purposes of the consideration of this subject, into organic and functional. In organic disease structural changes are present which are the result of inflammatory change, of vascular disease, or of degenerative conditions, some of which, at least, are toxic in origin. Others are spoken of as degenerative simply; but in some, possibly all, of these there is probably some toxic condition which determines the degenerative change. In a certain class of cases, especially those of the so-called condition of myelitis, it is not easy to discriminate between the different causal factors of the condition, for inflammatory phenomena are present, vascular occlusions are also met with, and degeneration of nervous structures is a constant sequel; and it is not easy to disentangle these different conditions in any given case. It may be said at once that for all such organic diseases no special dietetic rules can be laid down. The usual principles to be observed in the treatment of any acute disease are equally applicable to the acute diseases of the nervous system; for it must be remembered that those diseases are, to a large extent, not diseases of nervous tissue primarily, but really a condition in which disease in other structures leads to the impairment of function of parts of the nervous system. Thus, a case of hemiplegia, the result of occlusion or rupture of a vessel, is really a disease of the vascular system, or of the blood, and the consequent hemiplegia is the result of impaired function of certain nervous structures due to the cutting off of their blood supply. And even later, when actual degenerative changes have taken place in the nervous tissues, these are really of necrotic character, the defective supply of blood leading to the death of the tissues which it supplies. Thus, in malignant endocarditis we may have infarcts in the kidney and in the spleen; we may also have infarcts in the brain, and, as a consequence of that, a condition of hemiplegia. But such a condition is not, strictly speaking, a nervous disease, any more than an infarct of the spleen is a splenic disease, or a fracture of the skull with an injury to the Rolandic region, which causes hemiplegia, a nervous disease. Thus the treatment of the condition of hemiplegia, including the dietetic treatment, is the treatment of the condition which has given rise to the paralysis: and the treatment of the condition of myelitis, or other inflammatory diseases of the nervous system, is the treatment, so far as diet is concerned, to be observed in the treatment of any acute inflammatory affection of any organ or tissue. If the paralytic condition is the result of such conditions as render care in diet essential, for example, kidney disease, then, of course, the dietetic treatment of the nervous disease, so-called, is determined, or at least modified, by the kidney disease. Similarly the dietetic, and indeed the general treatment of such a condition as embolic hemiplegia in a patient the subject of heart disease is determined, to a large degree at least, by the condition of the heart.

Most degenerative diseases of the nervous system are probably toxic in origin. We know that such a condition as diphtheritic paralysis is definitely so. There are strong reasons for supposing that tabes dorsalis and general paralysis of the insane are a late result of syphilitic intoxication. It would seem, as Gowers has said, as if tabes and general paralysis have a relation to the microbe of syphilis analogous to that which alcoholic peripheral neuritis has to the yeast plant, only that the poison —alcohol—which gives rise to the peripheral neuritis is formed outside the body, whereas the presumed toxine which causes degeneration in the nervous system associated with tabes and general paralysis of the insane, is formed inside the body. Of the disease known as sub-acute combined sclerosis, so often associated with profound anæmia, there is good ground for suspecting that some toxic condition of the blood leads to the very interesting, and not infrequently symmetrical, changes in the spinal cord which are invariably found present in the disease. In pellagra, in which similar spinal cord changes are found, we know the condition to be the result of a poison present in unripe maize. In disseminated sclerosis no poison has yet been isolated, yet the nature of the clinical history of the condition and the conditions found post-mortem lead to the suspicion that the changes in the nervous system are the result of some toxic influence. Such considerations as those are important in reference to the dietetic treatment of the diseases only in so far as they may indicate that good, abundant, and easily-assimilated food must be given in order to maintain the health of the nervous structures, and so enable them to withstand the influence of poisons.

There is a class of nervous disease in which the obvious condition is one of slow, steady wasting or degeneration in certain structures. The cause of this is still obscure. It may be, as has been suggested, that these structures are endowed with a low vitality, and simply die young. If this is so, the condition may truly be called an *abiotrophic* one. It may be, on the other hand, that some toxic condition underlies this degeneration and determines it. In some cases such a view would seem to be favoured by the clinical history of the cases. In certain instances, for example, of progressive muscular atrophy, after a certain number of muscles have wasted, the result, no doubt, of wasting of the anterior horn cells, which subserve them, the process comes to an end and the disease ceases to be progressive. In such cases—and they are not very uncommon—it would seem as if the supply of the poison had been exhausted, no more being available to affect the still unaffected nerve cells. But even if we suppose that it is a poison which gives rise to those changes, we are still very much in the dark as to its origin. Whether it is a poison generated in the body, or whether it is imported from outside—and in this consideration the question of food will be of the greatest importance—we do not know. In another disease, exactly analagous to progressive muscular atrophy, namely, bulbar paralysis, we are confronted with the same problem. Those diseases are really identical in nature, and are frequently combined. There is another curious disease which Waren Tay first described in which there is a degeneration of the optic nerve and retina, and also a universal degeneration of the motor cells of the nervous system. In this condition, which appears to be invariably fatal, and which occurs in the first two years of life, almost invariably in children of Jewish parentage, we do not yet know whether the condition is one of simple early decay and death—abiotrophy—or whether it may be toxic in origin. Searching inquiries have been made into the feeding and dietary of these children. They have not all been breast-fed, but some have been. So that inquiries into the influence of diet would have to be extended further back than the period of lactation so as to discover any peculiarities in the diet of the mother during her pregnancy. At present we are quite ignorant of the determining cause of this condition, so that no special rules as to diet, with the view of averting or curing the condition, can be laid down.

Thus, then, in cases of organic nervous disease, no special rules are required as to diet, for we do not know of any diet which materially modifies the progress of those diseases. Still, there are certain conditions which occur in such diseases capable of being modified by special diet. It may be well to say a few words about some of those. In the early stage of **hemiplegia,** for example, whether it is the result of hæmorrhage, thrombosis, or embolism, the diet must be light, easy of digestion, and—especially if some difficulty of deglutition exists—capable of being easily swallowed. If unconsciousness be present, liquids are the only kind of food that can be administered. Occasionally swallowing is quite impossible, and then recourse must be had to rectal feeding. When this is necessary, there must be a good rectal wash-out at least once in twenty-four hours, and it is best to give small enemata of not more than half a pint every six hours. These should consist of peptonized milk or peptonized beef-tea, and an egg may also be given in the enema. One ounce of brandy should be added if conditions are present rendering stimulation necessary, as is frequently the case when thrombosis is the cause of hemiplegia, or when any condition of cardiac weakness is present. Such rectal feeding sometimes serves to bridge over the time of unconsciousness, but the outlook is always bad if the patient is unable to take some food by the mouth within thirty-six hours of the onset of paralysis. As soon as consciousness is recovered, milk should be given first, and during some days a dietary of milk, egg and beef-tea is all that can be permitted. Mastication is often difficult, and when the time comes to try solid food, it must be remembered that the food often tends to lodge on the paralysed side of the mouth, and to remain there for some time.

When unconsciousness is not present, there is no difficulty in feeding the patient, and the only point to remember is that, at first at least, the food should be light, for the most part liquid, and chiefly milk. If there be no rise of temperature, recourse may soon be had to bread and butter, fish and chicken. It is well to refrain from giving red meat for at least a week after the commencement of the illness.

With reference to **myelitis,** of whatever kind, whether transverse or limited to the grey matter—polio-myelitis—it need only be said that the diet to be adopted in the early stage is the light, easily-digested food suitable for any feverish condition.

Reference has already been made to **tabes dorsalis.** There is no diet which seems to modify the progress of the disease in its essential characters. It must always be remembered that in many cases there is a natural tendency to a condition in which the disease ceases to be progressive, a condition in which, apparently, the supply of the poison causing the degeneration seems to be exhausted. In such cases, abundant, easily-assimilated food, like milk, is of great advantage, and this is especially true of cases in which there is, as is frequently seen, a great tendency to wasting. Many tabetics, if left to themselves, become excessively thin ; yet if this tendency be early recognized, much can be done by the use of milk, cream, and fat bacon, and any other fats which can be taken and digested, to prevent the wasting going on to the undoubtedly harmful degree which it may attain. And in reference to tabes, it is well to remember the tendency, in certain cases, to the occurrence of gastric crises. Although it cannot be said that careful attention to diet will altogether prevent such attacks, yet it is undoubtedly true that any indiscretion may bring on a severe attack of vomiting, so that such patients have to be warned against the use of pastry, of much starchy food, or of anything in the nature of greasy or highly spiced food. Their dietary should consist of toast, fish, chicken, well-cooked meat, and very little vegetable. A little stewed fruit is sometimes advisable, and alcohol should be completely avoided. Yet, in spite of the greatest care, a crisis may come on in such a case, and as a rule it is not cut short by anything except morphia. Sometimes repeated small doses by the mouth are quite effective, but in the severe attacks, the use of the drug hypodermically is necessary. And when the vomiting has ceased, great care must be used in the resumption of food. It is advisable to put the patient, for the first two days, on milk in small quantities frequently repeated. Six, or even as little as four, ounces every two or three hours is usually quite enough, and during the first week after a crisis, milk and milk food should still remain the sole constituent of the diet. Sometimes, in spite of great care, there is a return of the vomiting after a day or two, but this tendency to the recurrence of sickness is certainly favoured by any indiscretion in diet.

There is one organic nervous disease in which diet is of much importance, namely, **alcoholic peripheral neuritis.** Although patients suffering from this disorder, when they first come under observation, are fat and apparently well nourished, occasionally they are emaciated quite out of proportion to the degree of paralysis. And even the fat ones not infrequently, after a few weeks of rest in bed and abstinence from alcohol, become actually wasted. In some of these cases, whether they are thin in the early stages or in the later, pulmonary tuberculosis may be actually present. It has been suggested that such a condition is possibly predisposed to by an actual neuritis of the vagus branches to the lungs: but whether that be so or not, there is no doubt of the fact that pulmonary tuberculosis is a not uncommon complication of peripheral alcoholic neuritis. Such a fact gives, of course, a very clear hint as to feeding, only the misfortune is that so frequently in such cases the appetite is capricious and the stomach irritable, so that it is very difficult to administer such food as is necessary, in sufficient quantity. It is often desirable to put such a patient on milk diet, and to gradually combine with such milk-feeding, the administration of good beef-tea, of fish, and, later, of well-cooked chicken or game, until the stomach is gradually brought to a condition in which it can tolerate a generous diet. Often the progress to this consummation is exceedingly slow, and such patients frequently dislike milk. But it must be persisted in, and when vigorous massage of the affected limbs is at last tolerated, such treatment will, of course, favour the administration of larger quantities of food. It is of the essence of treatment in such cases to try to keep up the weight. Occasionally one is disappointed with the result in a patient who came under observation, apparently of good colour and well nourished, but it must be remembered that such a patient has actually been living on alcohol, and taking very little food, so that the wasting which takes place under the changed conditions is only what might be expected. Yet it is essential in such cases to try, by such dietetic regulations as have been indicated, to prevent such wasting, and so remove what is undoubtedly a danger, namely, the tendency to the development of pulmonary phthisis. When this is definitely present, then the treatment of the peripheral neuritis should be combined, if possible, with the appropriate treatment for this condition.

Besides the organic diseases of the nervous system, there are certain morbid conditions in which the nervous symptoms consist mainly of disturbances in the functions of certain organs, no doubt determined by disease, yet in which the diseased condition is of uncertain character. Of these, one of the most important is **chorea.** It is necessary merely to allude to the pathology of this condition, in which fresh interest has recently been aroused by the work of Drs. Poynton and Payne. Their conclusions would seem to point to the existence of a microbe of acute rheumatism. On this hypothesis the phenomena of chorea are traceable to the presence of those microbes in the cerebral vessels. Such a pathology would bring the most modern views as to chorea into line with the views of Hughlings Jackson, Broadbent, and others, according to whom chorea has, as its underlying morbid anatomy, the presence of occluded small vessels in the cerebrum. Whether this view be adopted, or the other, which would regard chorea as the result of some toxic condition of the blood acting upon cerebral structures, the disease is frequently so severe in its effects as to make the feeding of the patient a matter of both difficulty and importance. In discussing chorea in this relation, it must be understood that we are considering the disease as apart from any manifestations of actual acute rheumatism. Frequently, of course, cardiac disease is present, but so long as it is not in an active stage of endocarditis or pericarditis, the treatment of the condition is the treatment of the chorea. Where active rheumatic conditions are present, the dietetic treatment of the condition, as well as the treatment by drugs, is determined by the condition of the acute rheumatism present. Little need be said of the treatment of chorea by drugs. The use of arsenic and other tonic drugs in small doses is probably not without a certain amount of good influence. The use of arsenic in large doses is frequently harmful, and is never justifiable. Rest, seclusion, and abundant feeding are the essentials for the successful treatment of chorea. In an ordinary case it is sufficient to give a full diet suitable to the age of the patient, with one or two added pints of milk. In severe cases the food is to be entirely liquid, and it may have to be given by the nasal tube. In such a case, milk, eggs, and strong beef-tea are the chief articles of diet, and alcohol should always be added in considerable quantity, as much as an ounce, or even 2 oz., to each feed. This is especially important in those cases which are admitted into hospital actually in a state of starvation, because the violence of the movements has prevented proper feeding. In such cases it is important to give no sedatives, especially of the chloral class, at least until the patient has had a good meal, with added alcohol. In some cases in which this rule has been neglected, severe and even fatal collapse has followed the administration of the sedative: and indeed in those cases, if such a meal as has been indicated, of milk, eggs, or beef-tea, with 1 or 2 oz. of whisky or brandy, be given, the sedative will probably be unnecessary, as the food itself will induce a sleep at once more wholesome, more natural, and more refreshing than any kind of sedative.

The quantity to be given will depend upon the age of the patient, but if any error is to be made, it had better be made on the side of giving too much rather than too little. An adolescent male or female—and such are usually the subjects of the severer form of chorea—should have at least 4 pints of liquid, beef-tea or milk, with three or four eggs, and as much as 6 oz. of alcohol in twenty-four hours. For a younger patient, a smaller quantity will be sufficient. It is desirable, again, to insist upon the need for using alcohol in those cases, and upon the necessity of always feeding a patient suffering from chorea, after admission to a hospital before any sedative is administered. As has already been said, the administration of a good meal will often obviate the need for any sedative. The nasal tube will only be used if the patient cannot swallow, and if it has to be used, it must be discontinued at the earliest possible moment.

Epilepsy.—It might be expected that in a disease like epilepsy, which shows itself in the definite if irregular recurrence of convulsive phenomena, the influence of diet might have been accurately ascertained. Yet it is apparently of so little consequence, in the opinion of those who have studied it and investigated it most closely, that in Sir William Gowers' classical work, which investigates over 3,000 cases, the subject of dietetic treatment is discussed and dismissed in little over a page. And when we consider our ignorance of the causes of epilepsy, this is scarcely to be wondered at. We know the disease only in its manifestations, the occurrence of convulsive seizures or attacks of unconsciousness of varying duration, and we know little or nothing of its underlying causes. Apparently, the necessary condition of the epileptic fit is an unstable state of certain cells in the brain cortex, a tendency in those cells to discharge, so as to give rise to convulsive movements of the muscles which they subserve, or to discharge in such a way as to leave other cells on a lower level of development free from the restraining influence of the higher cells. Further, these irritable cells seem to act as a fulminant, and so cause discharge in cells which are contiguous to them, cells in every respect healthy, yet which are induced to discharge by their unstable and excitable neighbours. It can readily be understood that their excitability is rendered obvious by different conditions.

There seems to be little doubt among different observers that emotional disturbance is one of the most common excitants of an epileptic fit. Any fright, any unusual excitement, any depressing emotion may determine a fit; yet it would not be correct to say that such an emotion might cause it. Similarly, a blow or a fall, that is, a physical shock as well as a psychical effect, may determine an attack, and so may any influence which modifies the circulation either by stimulating or depressing it. And this consideration probably explains the occurrence and recurrence of so-called nocturnal fits of epilepsy. Nothing is more striking, in investigating such nocturnal attacks, than the fact that, although they nearly always occur during the night, there are occasional diurnal attacks. Yet, on investigation, these diurnal attacks will be found to occur almost invariably during sleep, a chance sleep in which the patient has indulged during the day. So that such attacks of what is usually called nocturnal epilepsy are much more correctly to be described as attacks of epilepsy occurring during sleep, and the fact that they do so is, in all likelihood, to be ascribed to some modification of the circulation which occurs during sleep, giving rise to a condition of things which leads to a discharge from the unstable cortical cells. A curious confirmation of this view of epileptic fits occurring during sleep is to be found in the marked efficacy of cardiac stimulants like digitalis and nux vomica, in combination with bromides, in the treatment of those attacks.

Toxic conditions also are frequently an effective agent in evoking epileptic fits. Absinthe we know in experimental researches as one of the most effective producers of convulsion. It is not unlikely that, taken, as it frequently is, as a pick-me-up or appetizer, it may have a similar tendency to cause discharge in cells already predisposed. So also in uræmia, convulsions occur in no way distinguishable from epileptic convulsions. These two—the poison of absinthe and the poison of uræmia—are characteristic examples of exogenous and endogenous poisons producing convulsions. One cannot help asking the question—Does diet, or does any article of diet, especially in excess, produce some poison which may conceivably act in the same way as either of those? Much has been said and written about uric acid and its effects in producing nervous symptoms. Latterly, the pendulum has swung in the opposite direction, and now carbo-hydrates and purin bodies are the fashionable noxious agents. At different times, and by different observers, milk diet, a diet of milk, starchy food and vegetables, a purely vegetarian diet, a purin-free diet, and an ordinary mixed diet of bread and milk and vegetables have been vaunted as the diet most suitable for epileptics. The only point upon which all observers seem to be agreed is, that an excessive meat diet is bad for epileptics, just as it is probably injurious for other people.

There are certain general considerations to be dealt with in discussing the diet suitable to any particular disease such as epilepsy. First of all must be considered the individual idiosyncrasy. There is no doubt that some patients can take with impunity more animal food than others. The same is true, in a less degree, of starchy food. Some patients, even epileptics, are better with a considerable quantity of animal food: others are undoubtedly best without it and thrive on milk, eggs and vegetables. The vegetarian diet alone is, in my experience, bad. It leads to weakness, anæmia, and general debility, and through this, not infrequently, to an increase in the number of fits. But in reference to any dietary it must always be remembered that an epileptic is very often not only hungry and greedy, but frequently voracious, and that much care and judgment have to be used in reference to his food, no matter what diet is decided upon. My own experience has led me very definitely to believe that epileptics, as a rule, are best with a good mixed diet of meat, milk and vegetable food. I am also strongly of opinion that care must be used to prevent the patient from overe-ating, and to ensure that the food shall be good, simple, and well cooked. Beef, as a general rule, is to be avoided, but mutton, chicken, game, milk, and starchy food may be given in fair quantity. Pastry should be avoided. Cheese may be given in moderate quantity, but alcohol is practically inadmissible. A purin-free diet has lately been advocated, but is by no means a panacea, though probably useful in certain cases, and in those probably only for a certain time. The exclusion of salt has also been urged, especially in patients taking bromides. It has been said that such an exclusion tends to make bromides more effective in their action, but this is doubtful, and in the series of cases which I observed at Queen Square some years ago it could not be stated that patients deprived of salt did better with similar doses of bromide than did those who took salt regularly. Yet in reference to this also, considering the claims that have been made for the effects of this omission of salt, it is probable that individuals do occasionally progress better under such a régime.

In some cases of epilepsy the fits occur only in the early morning, often while the patient is dressing. When this is the case, the patient should have a light meal—a cup of milk and a biscuit, or a cup of tea and a biscuit, or some coffee and milk—half an hour before getting out of bed. This meal should be immediately followed by a dose of bromide; and in such cases, which are by no means uncommon, this mode of treatment is usually crowned with complete and permanent success.

My experience, then, of diet in epilepsy has led me definitely to conclude that it is necessary, in order to get the best results, to treat each case of epilepsy on its merits. In certain cases it will be found best to give a light diet, consisting of milk, eggs, starchy food, and vegetables, and whatever dose of bromide is necessary to control the attacks. In other cases—and these I believe to be so numerous as to constitute a large majority—a mixed diet, of meat, fish, milk, eggs, and vegetables, well but simply cooked, will be found best: while in others it may be found advantageous to give a dietary as free as possible from purin bodies. It is impossible to lay down a definite rule for all epileptics, yet in the majority, a simple mixed diet, by no means too abundant, will be found best. In some cases the omission of common salt may be found to allow the bromide which is given to act with advantage; but in this, even more than in most morbid conditions, one has to remember that the patient has to be treated, as well as the disease.

Graves' disease is one of the diseases which, on account of the obvious derangement of certain parts of the nervous system, is usually included amongst nervous diseases. The diet, in some cases of this disease, assumes much importance because of the rapid wasting which takes place. And this is especially true of cases in which violent attacks of diarrhœa occur repeatedly. Such cases are probably the most serious of all cases of this disease; they are certainly the most anxious that we have to deal with. When diarrhœa is present, the simplest milk food is practically all that is admissible, and this should be combined with lime-water, and in cases in which the diarrhœa is very severe, should even be peptonized. In ordinary cases of Graves' disease it has not been usual to pay any greater attention to diet than the general or special symptoms render necessary. Lately, however, a substance called Rodagen, an extract of milk obtained from goats from which the thyroid gland has been removed, has been used in the treatment of Graves' disease. Apparently it is not very effective in controlling the symptoms, although, according to Dr. Hector Mackenzie, it was seen in some cases to be followed by improvement, at least, in the general condition of the patient. Its use, however, and its mode of preparation have suggested to Dr. Mackenzie the desirability of trying the effect or helpfulness of a dietary in those cases, obtained from sources into which thyroid secretion does not enter. So he does not give his patients with Graves' disease milk in any quantity, and they have no beef, mutton, or veal. They are allowed all kinds of fish, fat bacon, chicken, eggs, fresh fruit, cream, butter, bread, and carb-ohydrates generally. And under this dietary—free, it will be seen, from anything into which thyroid secretion can enter, he believes that his patients do well. And, of course, if the practical effect is good, it certainly has theoretical considerations to recommend it.

So far as dietetics are concerned, a most important class of nervous diseases is that large class, perhaps increasing in numbers, under the strain and stress imposed upon the nervous system in present day modes of life, of disorders of the function of different parts of the nervous system without any organic or structural change appreciable by our present methods, in the anatomy of that system. To this large class of cases the term "**neurasthenia**" is now generally applied, but it is almost certain that as our experience of such cases enables us to recognize the different directions in which disorder of the nervous system may distribute itself, this class will naturally subdivide itself into several groups or varieties. Even now we are able to perceive varieties, somewhat indistinctly it is true, and to trace a gradation from comparatively trivial, unimportant disturbances of the nervous system, through profound and prolonged disorder, to cases in which it is difficult to draw a distinct line between so-called neurasthenic states and the grave functional disturbances of the nervous system which we know as mental disorders. It is desirable to refer briefly to the varieties of neurasthenia, in order to discriminate, as clearly as may be, between those cases in which dietetic rules and regulations are useful, and even curative, and those in which they are of comparatively little use.

Cerebral neurasthenia is that variety in which a condition of incapacity for work and for responsibility has been induced by excessive mental work, by constant and onerous responsibility, usually associated with much worry and anxiety, and emotional strain, perhaps, in reference to family or financial affairs. The patient usually complains of constant headache, yet when the headache is analysed, it is found to consist rather in abnormal cephalic sensations, not of a strictly painful character. Weight at the top of the head is frequently complained of, and pain and discomfort at the back of the head and in the neck is another frequent symptom. Unusual sounds on movement of the head are complained of, and some degree of tinnitus is often present. The patient is seen to be in a curiously sensitive condition. He is conscious of sensations which in the healthy are not perceived at all; ordinary duties assume an exaggerated aspect; he hesitates to come to any decision, being pulled first in one direction and then in another by the various considerations which come before him. He not only sees things through an enlarging medium, he sees them also distorted out of their true relations and their relative importance, and he is quite unable to use his judgment. Such a condition, from its very nature, is apt, unless forcibly interrupted by a complete cessation of work and by a change of environment, to perpetuate and intensify itself. The patient's bodily condition suffers, he becomes thin, loses his appetite and his sleep, and is in danger of becoming a chronic invalid.

In the so-called **spinal form of neurasthenia** the symptoms are mostly of the nature of what might be called spinal irritation. There is frequently pain of a severe character in the back, often throughout the length of the spine, but in many cases much intensified in the cervical region and in the region of the coccyx. With this pain is frequently associated weakness in the lower limbs, and a tendency to jerking and irritability of them. The knee-jerks are usually very active; there may be some pseudo-clonus present, but the plantar reflex is not of the extensor type, and indeed it may be difficult, or even impossible, to elicit any reflex at all from the sole. Such cases as this are frequently traumatic in origin, the so-called "railway spine." Yet it must be acknowledged that frequently all those signs and symptoms are present, yet without any previous accident, and without any pending action for damages. So that it is very important not to be misled into considering such cases in which an action is pending as necessarily or inevitably "constructive" in character. Head pains, especially in the occipital region, are frequently associated with these spinal symptoms, and this fact goes to show that the classification which is attempted here is, in a great degree, artificial in character.

Although those two classes of neurasthenia are fairly distinct, numerous cases occur in which both sets of symptoms are present, one set, perhaps, predominating. And in reference to cases of so-called **sexual neurasthenia,** in which the patient's thoughts are much occupied with the misinterpretation of sexual sensations, or with the fear and apprehension of sexual impotence, or with remorse for some form of sexual depravity and dread of its consequences—in these cases also the sensations and symptoms described in the cerebral and spinal types may be present. So that in neurasthenia it must be recognized that we are dealing with a malady of numerous phases, and that the symptoms depend upon a condition of weakness or exhaustion of the nervous system, in any or all its parts, and that this is associated with a strong introspective tendency which exaggerates and perverts and distorts any symptoms which may be present.

There is a large and important group of cases to which Weir Mitchell first called attention, consisting of the most part of women, who have become thin, dyspeptic and anæmic, who are unable to take exercise without excessive fatigue, in whom slight exertion causes palpitation or actual distress, or who are frequently "highly-strung" and emotional. In many such cases the determining cause of ill-health has been some prolonged strain of anxiety in reference to illness of a near and often a dear relation, frequently combined with the actual nursing of the relation. When one considers the frequently exacting character of the duties which such a one imposes upon herself—the irregular and often scanty meals, the long hours of devoted duty in a sickroom, the absence of fresh air and of exercise and the ever present anxiety—it is not to be wondered at that ill-health is often the result. And one also has to remember how frequently chronic illness breeds selfishness and how such a patient often becomes an actual "vampire," as Oliver Wendell Holmes puts it, to all about her, and most of all to those most devoted to her. It is not to be wondered at that so often the termination of such an illness leaves several of the household in a condition of almost complete prostration. No doubt, it is the case that occasionally under judicious management by means of change, and variety, and care, such cases of exhaustion get well without any recourse to special treatment. Yet in others the condition does not improve, pain and dyspepsia and even local uterine trouble may be superadded, too much attention may be paid to this as a cause of illness when it is merely a symptom, and salvation may be sought at the hands of the gynæcologist. But it must be added that nowadays many gynæcologists recognize the condition and take steps to remedy it by the general line of treatment which will be alluded to presently.

There is one variety of the condition to which particular attention should be called. It was first described by Sir William Gull under the name of **anorexia nervosa,** and the trying conditions alluded to above as so frequently productive of the condition are by no means an invariable precursor in this variety. The subject of it is usually a girl between the ages of seventeen and twenty-five, although I have known it occur in a woman over thirty. The patients are usually energetic, and not infrequently have some particular hobby to which they are devoted. Carelessness about food and the absence of any compelling appetite lead to irregularity in feeding, the meals become scrappy and meagre and the patient gradually wastes. The loss of appetite grows, food becomes positively distasteful, and even moderate indulgence in it leads to nausea or actual retching, and the vomiting of a little mucus. The patient becomes still thinner, weakness is superadded, walking becomes more and more difficult, but even when extreme emaciation has occurred the patient may still be able to walk about. But she is then nothing more than a living skeleton, and she seems to be in the last stage of phthisis, although there is no cough and no evidence of lung disease. Such a patient may actually die, apparently simply exhausted, or she may become infected with some malady which will bring about death. Yet if she is taken in hand and treated properly, she will become quite well, and any one who has watched such a case get well will confess that no more gratifying experience can be met with in medicine than the cure of such a condition.

In reference to all those varieties of neurasthenia—and it must be remembered that either sex may suffer—rest, change of environment, abundant feeding, and such drugs and food as will improve the condition of the blood, comprise the methods of treatment. Yet it is only by working out the details of such treatment with judgment and care, and adapting them to the individual case, that success will be obtained. In many cases it will be sufficient to send the patients away to a bracing place with some suitable companion who will see that the directions as to fresh air, exercise and abundant food, are carried out. Those are the milder cases in which no prolonged building up may be necessary—men and women who still retain their recuperative capacity, who have not developed the achings, the tiredness, the actual inability to walk and the restlessness and sleeplessness which characterize the worst cases; they are simple cases to deal with, although even in such it is often a good plan to put the patient to bed for a week, to feed her up, and if she fails to assimilate her food to let her walk for an hour each day or have massage for two hours.

In severe cases of neurasthenia, however, such a simple plan is inadmissible. The various aches of the patient, her weak and anæmic condition, her inability to walk even, without experiencing disagreeable and trying palpitation, all make such an active treatment impossible. For such patients what has to be done is to adopt some means of getting them into good condition. This can only be done by rest and by abundant feeding. Yet rest with abundant feeding and without exercise in such cases will soon bring discomfort and dyspepsia, and so make the condition worse. So that a substitute has to be found for the exercise which the patient is too weak to take but which is necessary if the food is to be assimilated. This substitute for active exercise is found in passive exercise—massage of the muscles—rubbing and kneading and pinching them, forcing blood through them and leading to such changes in their metabolism, and in that of the organs generally, as would be effected by vigorous active exercise. Another adjuvant in this matter is electricity. The use of a strong but not painful faradic current in such cases is helpful. It causes muscular action without fatigue, and although it is certainly not so useful as massage, it is by no means to be despised for its active physical effects.

It will now be desirable to go into some detail with reference to the care and treatment of one of these severe cases. The patient must, of course, be separated from her friends and her habitual environment, and she must have as a nurse a capable, kind, and sympathetic but unemotional person. All letters must be forbidden, even the daily paper stopped, and the treatment should be carried out in a large, well-lighted, airy room. Absolute rest in bed is essential. The patient is not, at first at least, allowed out of bed for any purpose, and for the first three days nothing is to be given except milk and rusks. The milk should be given in quantities of 4 oz. every two hours at first, but the total quantity in twenty-four hours should be increased in three days to 2 quarts. It is undesirable to wake the patient in the night, but her milk should be placed by her bed and she must drink it if she wakes. After three days of this simple diet of milk and rusks a small morning meal is given—a little fish and bread and butter, and bread and butter with milk in the evening. Then two days later, i.e. on the fifth day of treatment, a cutlet may be given in the middle of the day, and in two or three days more three light meals should be taken in addition to the 2 quarts of milk. The character of the meals can be left to the patient and nurse, but fat bacon and an egg in the morning, a chop or cutlet and stewed fruit and cream in the middle of the day, and fish with butter-sauce in the evening, will indicate the kind of meals desirable.

All this time, of course, the massage and electrical treatment go on, the first day twenty minutes' massage morning and afternoon or evening should be given, next day half an hour twice daily, and on the fifth day an hour twice daily. The faradic current should be used twice daily for a quarter of an hour at a time. At the end of ten days raw meat-juice should be given, 1 oz. daily. If it is very unpalatable to the patient, it can often be easily given in milk, or the meat may be quickly cooked on the outside and the juice squeezed out. Such juice from partly-cooked meat is much less unpalatable than the real raw meat-juice.

There is, of course, often trouble with the bowels. A dose of calomel is usually desirable about the third day, but after that it is usually easy to regulate the bowels with the fruit and butter and cream, or if that is insufficient, a small nightly dose of cascara and nux vomica will usually suffice.

Difficulties are, of course, encountered in most cases, but with the rationale of the treatment—the combination of rest with the assimilation of much nourishing food—before one's eyes, these difficulties will usually vanish. The patient's objections to going on have sometimes to be overcome, but as a rule they are not serious—the chief difficulty being usually, in the first place, to obtain consent to the treatment. When a patient has once definitely made up her mind to go through with it, the occasional objections that she afterwards raises are, as a rule, easily overcome.

Such are the methods to be followed in cases subjected to this treatment, and in many of them the results are most satisfactory and striking. Yet there are others in which disappointment is met with. These are cases usually in which the habit of absence of effort and initiative is deeply ingrained, and although temporary success is sometimes met with in those, a relapse into the old condition is apt to occur.

With reference to the cases of *anorexia nervosa* to which reference has been made, these must be treated on exactly the same lines as those just described. The desideratum in these cases, as in the others, is to fatten the patient and to improve the condition of the blood. The fattening process is usually rapid, and I have known a case of this character weighing 4½ stone on admission to the Home go out in eight weeks' time weighing just twice as much.

This treatment by rest, isolation, massage and abundant feeding is also of the greatest use in most cases of traumatic neurasthenia whether with predominating cerebral or spinal symptoms. In the severer cases, as a rule, such treatment is inefficacious, although occasionally modified success is met with. And it may be stated, as a general rule, that in all cases of depraved and lowered nerve function treatment of this character, the object of which is by improving nutrition to restore a normal condition of the nervous system, is to be strongly urged. It may not be invariably successful, but it will succeed in the majority of cases of neurasthenia in effecting a complete cure, and in the others it nearly always leads to very definite improvement.

DIET IN DISEASES OF THE SKIN

CHAPTER XXIV

DIET IN DISEASES OF THE SKIN

BY T. COLCOTT FOX, M.B., F.R.C.P.

General considerations.—In a discussion of the dietetic treatment of diseases of the integumentary system we are faced with the uncertainty or complicated etiology of many of them. To enable the reader to attack the problems under discussion with the knowledge that we at present possess, it will be convenient to survey the morbid processes according to the etiological classification arranged by Louis Brocq of the Hôpital St. Louis in Paris. It will be apparent that in a large number of cases the diet, though not without importance, is a secondary or minor factor in the treatment, yet it has to be adjusted in relation to the different stages of the malady or complicating lesions of important organs. But there are affections, such as **pellagra** and some forms of **urticaria,** directly associated with a diet which is noxious to the patient, and it is very necessary to realize that in many skin eruptions the predisposition or vulnerability of the soil is an all important factor, and may be contributed to by improper diet or imperfect metabolism of foods. Then again the excessive use of alcohol notoriously helps to render eruptions aggressive and intractable, and in some people leads to the excessive formation of fat, diffuse or in peculiar tumours, and such persons are liable to acquire a vulnerability of the skin leading to rupture of the elastic tissue and the condition known as **linear atrophy.**

I propose in this chapter to indicate chiefly the general principles on which dieting in the various skin diseases should be arranged, for the details of diets proper for gouty, obese, diabetic and other subjects will appear elsewhere in the book.

The important thing is to grasp the principles on which special diets are indicated, and then the observer can fill in the details, for as will be seen some cases differ greatly in the complexity of their etiology.

Group I, entitled the **true morbid entities,** includes the class of **artificial dermatoses** due to external causes such as traumatisms, mechanical, physical, chemical; irritating secretions as in intertrigo and the dermatitis genitalium from diabetic urine; artefact lesions; and the huge group of occupation dermatoses. It is important to realize the fact that damage and reaction may vary with the vulnerability of the soil, and a well regulated bland diet is desirable in the treatment, and to prevent recurrences, for some irritants are only effective when acting on a vulnerable soil. It is our daily experience to see a washerwoman or scrubber go unscathed for years, and then her health deteriorates from some cause, and the irritants encountered in her occupation excite a dermatitis. We shall have something more to say on this point when we speak of eczema. In chilblains we see the vulnerable soil due to a weak circulation, which is often associated with poor nutrition, and the excitant in the onset of cold weather. It is evident that the general nutrition should be fostered by generous feeding, including much fatty diet.

The dermatoses excited by ingested aliments and medicaments are next to be considered. Here an inherited or acquired vulnerability often comes into play. It is well known that certain articles of diet disagree temporarily or persistently with some people, e.g. strawberries, or tea or coffee, and again certain foods may on occasion contain special poisons, as diseased maize, mussels, tinned foods and pies.

The second class of Group I comprises the numerous and important **diseases excited by animal and vegetable parasites.** Some are superficial and unassociated with any toxic poisoning which we can trace, such as the mould parasitic affections of the epidermis, and it is not known that diet can in any way influence the growth of the parasites, although certain local conditions favour their growth. For instance, the microsporon loves the child's hair, and the parasite causing tinea versicolor likes covered warm perspiring parts of the body, and it thus not infrequently attacks delicate people who clothe warmly, such as those predisposed to tuberculosis. Hence the presence of this disease may give a hint for good feeding to improve the general nutrition. Of the microbic infections streptococci, causing the common impetigo contagiosa, and the so-called pemphigus neonatorum, and staphylococci causing the pustular impetigo, boils and carbuncles, may set up a notable toxic poisoning, and rarely a general infection. There are qualities of the soil which offer a diminished resistance to the growth of these organisms, which may vary in virulence, and therefore it is important in addition to the specific treatment to strengthen the nutrition by plenty of good food. The existence of diabetes or glycosuria is well known to favour the growth of staphylococci, and demands the appropriate dieting for these conditions. Though the proof of its parasitic nature is not absolutely assured, I mention here the very common phases of pityriasis of the scalp and other parts including the "flannel rash," states nowadays often described as eczema seborrhoeicum or seborrhoeides. I do not recognize that any special diet influences these eruptions. Then we come to the more formidable infective granulomata, such as tuberculosis, syphilis and leprosy. There is no special diet indicated in these infections, but a building up, as far as possible, of the general nutrition. Modifications are of course called for in different stages, such as acute febrile phases, implication of important organs, and so on.

The phase of tuberculosis known as **lupus vulgaris,** constantly illustrates for us the importance of attending to the deficient resistance of the soil. It often occurs in persons who have inherited a deficient standard of nutrition with a feeble circulation, and there is added to this a chronic poisoning from the tubercle bacilli and the wounds which may be produced. Such patients require to be placed under the most favourable conditions as regards diet, in order to increase the resistance of the tissues as far as possible. Fatty foods are an important indication. In regard to **syphilis** a special point to be noted in regard to diet is that the state of the gastro-intestinal tract must be carefully supervised and green vegetables given with caution whilst mercury is being pushed. Lastly, there are acute febrile infections, such as acute pemphigus, and the infective purpuras which must be dieted like the acute specific fevers.

Group II includes a huge heterogeneous group of dermatoses which Brocq characterizes as **cutaneous reactions.** An eruption very similar in appearance may be excited by several causes, and possibly one and the same cause may set up different types of reaction. The etiology is often complicated or obscure and some of the factors determining the phase of reaction often escape our recognition. It is in some of these reactions that dermatologists most strongly advocate special diets, and though such treatment has a sure foundation in some cases, in others the dieting is largely due to the belief arising from exclusion of other agencies that a metabolic disturbance must be the cause.

Class I of this group consists of the **cutaneous reactions proper,** and includes a series of **reactions with pruritus as a leading symptom,** e.g. the functional disorder known as **pruritus,** uncomplicated or associated with a special vulnerability of the skin leading to inflammatory or other reactions known as **lichenification, urticaria, acute circumscribed œdema, autographism, lichen urticatus** and **the prurigos, eczema, dermatitis herpetiformis,** and **generalized erythrodermias.**

Pruritus, or the symptom of itching, is due to disturbance of function of the sensory nerves, and may occur quite apart from any co-existent eruption which involves these nerves. The conditions determining the pruritus may be innate or acquired in the nervous system, and in certain persons whose sensory nerves are, so to speak, on edge all sorts of slight influences may excite itching, such as undressing, the warmth of bed, a bath, cold, etc. Then the symptom may be excited reflexly as exemplified in the nasal and anal itching due to thread worms in the lower bowel. The sensory nerves again may be disturbed by the circulation in the tissue of noxious products elaborated in the system, as in diabetes and jaundice, or accumulated by faulty elimination. Sometimes people have an idiosyncrasy against certain articles of diet, and tea and coffee are not infrequently incriminated. In the common senile pruritus it is often difficult to estimate the relative potency of such factors as atrophic skin changes, metabolic disorders, and inefficient elimination. Obviously where the diet or digestive organs are in any way at fault or the elimination of waste products imperfect, we must meet the difficulties by an appropriate diet. In some intractable cases it is advisable to try for a period some special diet, such as the milk, or lacto-vegetarian, or Salisbury cure.

Urticaria is the result of a special kind of reaction of the skin in which the vaso-motor nerve system is specially involved, and may be excited by external or internal irritants, directly as in a nettle sting, or reflexly in some visceral irritation (stomach and genital organs). It is well known that some poisons, e.g. that formed in certain mussels, may be powerful enough to induce the vaso-motor trouble in any one ingesting the food. There are persons also who, temporarily or persistently, have an idiosyncrasy against certain articles of diet, or whose digestive power is, at any rate for a time, imperfect for such food, and in them this special reaction is excited, though such articles of diet are innocuous to the general run of people. Toxins formed in the intestines are also incriminated. On the other hand, the cutaneous vaso-motor nerve system seems to be in a very unstable condition, and then the slightest stimuli produce the wheals. A striking example of this is seen in autographism; and in the effects of undressing or getting warm in bed in certain subjects. Of late years the state of the blood has been investigated in cases of urticaria, and in some instances found deficient in coagulation power, readily allowing "serous hæmorrhages." Alcoholism has a special tendency to impair the tone of the vaso-motor nerves, and also acts by causing gastro-intestinal and liver troubles. From these remarks the lesson will be learnt that in urticaria we must thoroughly investigate the state of the nervous system, inherited or acquired, and look carefully for an exciting cause in the food intake and digestion, and examine the urine for evidences of imperfect elimination, and correct what is wrong by insisting on a diet simple in quantity and quality. In some distressing chronic cases it will be found expedient to experiment for a time with a special dietary, as milk, lacto-vegetarian, etc.

Lichen urticatus and **the prurigos** are closely related to urticaria, and here again we meet with a highly susceptible vasomotor or sensory nerve system set in action by a variety of excitants, which often elude our investigation. Lichen urticatus is a recurrent eruption of early childhood, and often proves most intractable. It especially evolves in the evening. After the exclusion of all possible external excitants, such as irritating and heating clothing and fleas, it is desirable to minutely investigate the functioning of the gastro-intestinal tract with a view to seeing that the digestion is well performed, and that no poisonous excitants are elaborated. The quantity and quality of the food must be carefully adjusted according to the age of the child. Some French authors insist on the frequency of dilatation of the stomach. The prurigos are characterized by the repeated formation of itching papules with many analogies with the wheal, and the reaction is met with under several conditions. In the commoner form beginning in childhood, there seems to be an ingrained state of cutaneous nerve instability, so that the eruption may be lifelong. The subjects of this eruption are characteristically pallid and spare. Here, again, as for lichen urticatus we protect the skin from all external excitement, and endeavour to prevent any possible source of irritation by careful dieting, and seeing that the gastro-intestinal functions are perfectly carried out. As in the other reactions in which the cutaneous nervous system is especially involved, a protection of the skin by an occlusive dressing goes far to stop the evolution of eruption, and seems to point to the importance of external irritation. Nevertheless the existence of dyspeptic and metabolic troubles has a strong hold on the profession, at any rate as a predisposing cause.

Eczema is an inflammatory reaction of the skin of a different type, and probably due to a diversity of causes, often complicated. For a patient may inherit a state of nutrition predisposing to it, or acquire such by his habits and mode of life, and then various exciting causes come into play and complete the story. Eczema is not a parasitic disease, although the pyogenic cocci find a congenial soil in the inflammatory area, and are frequently a cause of the persistence of the trouble.

To repeat what we have said about other reactions it is important to bear in mind that, although many irritants are potent enough to inflame any skin (*see* ARTIFICIAL DERMATOSES), there are states of malnutrition brought about by inherited or acquired influences which make the skin abnormally vulnerable. In such cases external irritants of little potency, such as a cold wind or sun exposure, will suffice to excite an eczema. Thus we constantly observe masons, bakers, polishers, laundry-women, scrubbers, etc., who suddenly become attacked with eczema, because the resistance of their skin tissues has diminished from various causes. These causes comprise all the factors that go to make up the mode of life and inherited tendencies. Thus we find associated with the eczema reaction such states as anæmia, gout, liver and gastro-intestinal disorders, oxaluria, lithiasis, diabetes, obesity, asthma, chronic bronchitis and interstitial nephritis. It is almost universally held that various disorders of metabolism, the excessive intake of foods or certain foods especially with a sedentary life, and deficient elimination may strongly predispose to eczema, and it is possible that certain toxic products may actually be the excitants, but our knowledge is not very sure on this point. Certain it is that we meet with many cases in which no clue to external excitement can be traced, and on the other hand it is sometimes impossible to detect any metabolic disorder. The state of the nervous system probably has a marked influence, either directly or indirectly, in the causation of certain cases of eczema. We meet with it in neurotic individuals who live carefully, and attacks seem to be excited sometimes by strong mental strain.

It will be gathered from these remarks that in planning a treatment for a case of eczema it will be desirable to make an exhaustive examination into the general health of the subject, and the functioning of the various organs, especially the gastro-intestinal tract, liver and kidneys; to note the mode of life and habits, especially as regards the quality and quantity of the diet, the consumption of alcohol and amount of tobacco smoked. The diet arranged must obviously depend to some extent on the condition present, whether gout, diabetes, etc. Eczema may occur in low states of nutrition from want of proper food; on the other hand, in most cases it is well to impress the necessity of slow mastication; to diminish the quantity of food; to take easily digestible bland foods such as, for dinner, a sole, chicken and milk pudding; to avoid pig flesh, sweets, pastry, and fruits, piquant sauces, oily fish, curries, and to cut off alcohol or greatly limit its use. A little sound whisky, if any alcohol, is usually allowed. Salted foods are very commonly prohibited, and tea and coffee may not agree. In acute and obstinate cases it is useful to cut down the meals to a minimum, and even for a time put the patient on special diet (milk, lacto-vegetarian, etc.), the details of which are given elsewhere.

As for the very common and troublesome **infantile eczema** we ought to be in a position to understand the etiology, for many complicated factors acquired by the adult are absent. Nevertheless, we are very far from thoroughly understanding the etiology. Allowing that the cutaneous nervous system is in an excitable condition in the infant, we have two categories of provocatives, external irritants of various kinds and gastro-intestinal troubles often due to improper feeding as regards quantity and quality. It is therefore of the first importance to have the child fed on proper principles in every respect. Some of the most troublesome cases are those in which infants seem to have idiosyncrasies against certain foods. Having spent a large portion of my life in observing babies suffering from eczema, I have watched many who were apparently, apart from their eczema, perfectly healthy in every respect and properly fed; and in my opinion a great deal of so-called infantile eczema belongs to the pityriasis group and is purely a skin disease, except that the susceptibility of the soil is important. It is notable that the eczema so frequently commences by the scalp, and descends over the face and elsewhere. It is often characterized by pityriasic patches which become readily "eczematized" by external irritation, and is then indistinguishable from true eczema.

Dermatitis herpetiformis, formerly included with pemphigus, is an uncommon eruption of which the etiology is often obscure. Some cases are thought to be from nervous breakdown, or from intestinal auto-intoxication inferred from the eosinophilia of the blood and indicanuria. However that may be, a careful nutritious diet is called for.

Lichen planus of E. Wilson is also generally considered to be dependent on the state of the nervous system. This opinion is founded on the facts that the subjects are often obviously neurotic, and not infrequently the eruption follows marked shock, emotion, worry, etc., or coincides with the climacteric period. The general health may be unsatisfactory, and nervous dyspepsia exist, which calls for careful dieting. Sometimes very acute cases occur, and demand a simple bland diet with absence of any stimulating food.

Generalized erythrodermia is rare, and the etiology often obscure. It is known that various chronic skin eruptions, such as eczema and psoriasis may take on this severe phase, and such a skin condition has been seen in tuberculosis, lymphadenoma, and other conditions. The cutaneous vaso-motor system seems to lose all tone. Here again a simple, nutritious, bland diet is called for.

The second section of the proper cutaneous reactions is characterized by the absence of pruritus as a dominant feature, and it includes such disorders as the great group of **erythemata, herpes simplex and zoster, pemphigus, psoriasis,** and **pityriasis rubra pilaris.**

The erythemata, which vary in type from the rashes simulating those of some of the acute specific fevers to macular, papular, nodular, and bullous eruptions, hæmorrhagic or not, are probably all of toxic origin. Many are certainly so, e.g. the serum and antitoxic rashes, the drug rashes, the pre-eruptive and secondary rashes of the acute specific fevers, the erythemata of rheumatic fever, the so-called "surgical scarlet fever" and septicæmic eruptions, and the eruption in late Bright's disease. Sometimes there is only one passing attack, but it may be febrile and severe, and demands an appropriate diet. At other times the outbreaks are recurrent at irregular intervals for years, as in **erythema (herpes) iris** and the remarkable **recurrent scarlatiniform desquamative erythema.** Obscure as the etiology of many of these cases is, it is important to carefully investigate the state and functioning of the gastro-intestinal tract, and to pay especial attention to the diet with a view to discover some error or idiosyncrasy, and so put a stop to the recurrent attacks.

Lupus erythematosus may be discussed here. It is believed by many dermatologists to be intimately connected with tuberculosis, i.e. brought about in some way by the products of tubercle bacilli. My own view is that it is of toxæmic origin, not necessarily tuberculous, but occurring in people with poor nutrition and weak circulation, and often no doubt with tuberculous glands. The usual indications for dieting are that these patients want building up and supporting by a generous and fatty diet.

Herpes simplex or febrilis is well known to be excited, probably reflexly, about the muco-cutaneous orifices chiefly by a multitude of recurrent causes, such as the catamenia, sexual congress, febrile movement in colds, pneumonia, etc., and often without obvious cause. **Herpes zoster,** on the other hand, is caused by an inflammation of the nerve ganglia, and this may be set up by traumatism, or the ingestion of arsenic, but usually, it is thought, by a special infection. These eruptions do not call for special dieting.

Pemphigus is a term applied to a collection of bullous eruptions of uncertain etiology, after exclusion of the bullous phases of such eruptions as streptococcic impetigo, erythema multiforme and lichen planus, potassium iodide dermatitis, etc. The only thing to be said is that, apart from the severity of the attack calling for special diet, it will be advisable to carefully investigate for any source of toxic poisoning in the intestinal tract.

Pityriasis rubra pilaris is another rare relapsing eruption, the pathogeny of which is unknown, but there are no special indications for any particular diet.

Psoriasis again, a recurrent eruption of daily observation, has a very obscure etiology, and it is consequently in obstinate cases that all sorts of diet and spa treatment are tried. Its parasitic origin is unproved. It has been thought to be a local disease of the skin which may be inherited. Many observers consider it symptomatic of a neurosis, but most frequently of some dyscrasia. The fact is psoriasis seems to be a reaction predisposed to or due to many kinds of causes, and consequently we meet with it in all sorts and conditions of people, whether apparently healthy and even robust, or rheumatic and gouty, alcoholic, plethoric, obese, and what not. The complication by trophic joint changes in a proportion of old-standing cases suggests a toxæmia, but perhaps not for all cases. Apart from the exciting cause or causes of psoriasis we may note the effect of constitutional states on it, for a fever may clear it off for a time. The excessive use of alcohol makes it incurable, and the demand on a woman's strength, when suckling, has a marked effect in making a psoriasis intractable or causing it to evolve.

The upshot of all this is that, as in other reactions, a most careful investigation must be made into the constitution of the patient, the functioning of the organs, the habits and mode of life, and anything that is wrong should be corrected as far as possible. The patient should understand that any disturbance of the health will probably "discover" the eruption. The diverse states of health, such as various metabolic disturbances, which may be associated with this psoriasis reaction, explains the benefit sometimes derived from a course at various spas and from strict dieting, such as is carried out at various German health institutes. In presence of a case of psoriasis then, it is desirable to prescribe a diet in relation to any improper feeding or any disordered condition present. But, although we have no proof that any particular diet is a cause of psoriasis, some dermatologists as a routine treatment recommend an absolutely vegetarian diet; eggs, fish and pastry are forbidden, sweets limited, milk not taken with meals, and often coffee and tea interdicted. In severe cases, especially with trophic bone changes, it is certainly expedient to judiciously experiment with a strict vegetarian or lacto-vegetarian, or Salisbury treatment, as most favourable results have unquestionably resulted on occasion.

Xanthoma is considered by some to be a neoplasm, but to my mind it is a special reaction of the skin brought about by one or more agents. We see one form occurring in various liver affections associated with jaundice, e.g. gall stones, and the xanthoma may disappear with the removal of the gall stones and jaundice. I have seen a hypertrophic cirrhosis of the liver become quiescent and the liver diminishing with gradual disappearance of the xanthoma, suggesting the cessation of manufacture of some toxic agent. Then we have forms of xanthoma associated with glycosuria and diabetes, and lastly eruptions without evident cause. What the toxic agent common to all these conditions is we do not know. The xanthoma of glycosurics and diabetics is strikingly affected for the better by special diet.

Acne rosacea is a term which includes so-called seborrhœic dermatitis of the face, but especially recurrent and the stereotyped hyperæmia of the face caused by constant external producers of local blood congestion such as sun, wind, fire, heat, etc., and frequently reflex from gastro-intestinal, and in the female, genital disorders. In the gastro-intestinal cases a careful dieting, and exclusion of large quantities of badly made tea, and excess of alcohol is most essential.

We now come to **Class II of cutaneous reactions in which the nervous system is prominently involved.** The reaction may occur in course of a defined nerve lesion, as **syringomyelia, hysteria,** and **dermatophobia**; or as secondary to internal secretory troubles, as **exophthalmic goitre** and **myxœdema** and **Addison's disease**; or as trophoneurotic syndromata illustrated by such conditions as **Raynaud's symptoms, erythromelalgia, erythromelie, scleroderma, nerve panaris, hemiatrophia facialis, ainhum, perforating ulcer, recurrent phylctenosis of the extremities, epidermolysis, alopecias,** and **secretory troubles of the sweat and sebaceous glands**; or as the pigmentary disturbance known as **vitiligo** or **leucoderma.** None of these troubles seem to be directly affected by diet, and, as a rule, only a rational diet is called for. I have often seen **leucoderma** in spare, delicate-looking children, which suggested the importance of a specially nutritious diet to avert tuberculosis. In the **sweat secretory troubles** it is advisable to avoid stimulating food, and excess of fluid, which are apt to increase the trouble. Opinions differ as to the cause of **acne vulgaris**. It is a reaction of the period of evolution of puberty, and is associated with excessive output of sebum, plugging of the sebaceous follicles, and secondary papulo-pustular complications from the growth of staphylococci. The plugs consist of a proliferation of epidermic cells in the mouths of the follicles enclosing, and caused by, myriads of micro-bacilli. Whether these bacilli, which certainly cause the plugging of the mouth of the follicle, are the cause of the seborrhœa and consecutive changes, or whether the seborrhœa is a functional disorder of puberty affording a congenial soil for the bacilli is in dispute. These acne patients are often debilitated generally, and frequently are dyspeptic and constipated, so that a simple bland and laxative diet is called for. Some French dermatologists cut off all fatty food.

Class III comprises the cutaneous reactions characterized by nutrition troubles, and includes (A) changes characterized by exaggeration of nutrition, (*a*) of the epithelium as in **keratosis pilaris, lichen spinulosus, keratosis follicularis vegetans, acanthosis nigricans, porokeratosis,** and **keratosis palmaris et plantaris ;** (*b*) of pigment, (*c*) of hairs, (*d*) of the dermis, as in dermatolysis and soft nævi ; (*e*) of subcutaneous cellular tissue as in many nævi ; (B) changes characterized by diminution of nutrition, as in albinism, canities, alopecia, trichorexis nodosa, monilithrix, primary nail and cutaneous atrophy ; and (C) mixed acquired dystrophies of the hair and nails ; of epidermis and dermis, as in ichthyosis, xeroderma pigmentosum and colloid milium ; of the elastic tissue, as in pseudo-xanthoma elastica. There are not any special diet indications in this class.

Lastly, there is **Class IV of cutaneous neoplasms** which need not be discussed.

DIET IN OLD AGE

CHAPTER XXV

DIET IN OLD AGE

BY HARRY CAMPBELL, M.D., F.R.C.P.

The teeth of the aged.—All are familiar with the toothless gums of the aged. In advanced age the teeth tend to loosen and drop out, from atrophy of the alveolar processes. This occurs sooner among civilized than among primitive peoples, owing to the insufficient use to which the teeth are put in the former case (whence results atrophy of the alveolar wall) and to the prevalence of pyorrhœa alveolaris. Complete absence of teeth must, indeed, have been practically unknown before the introduction of cookery, inasmuch as most vegetable food in the raw state needs abundant chewing, and it may therefore be regarded as certain that before the practice of cooking became common man rarely, if ever, reached the stage of edentulism. Long before his teeth had a chance of dropping out from senile decay, we may be sure that they were ground down to the gums (as may be observed in other vegetable-feeding animals) by the laborious chewing of dense vegetable substances, and by this time it must already have been very difficult to support life. It is probable that before the introduction of cookery the old were able to assist the work of their teeth by artificial means, such as grinding and maceration—means which, it may be remembered, are found of great service in the feeding of old horses with teeth much ground down.

In the pre-cookery period dental caries, it should here be observed, was practically unknown in man.

Then came a change. With the advent of cookery survival was no longer so closely dependent upon dental efficiency as it had been, inasmuch as cooking, by breaking up the nondigestible cellulose meshwork of the denser varieties of vegetable food, relieved the work of the teeth, and it became possible for people to survive with very inefficient teeth, or indeed, without any teeth at all. Nevertheless it is very doubtful whether in the early period of cookery—before i.e. the introduction of agriculture—life was long maintained after the teeth began to give out. Certain it is that edentulism must have been very rare in pre-agricultural times: we do not remember to have seen a single toothless jaw among the numerous skulls that we have examined of extant pre-agricultural peoples, all of whom were skilled in cookery.

When the age of agriculture was reached the supply of soft vegetable food underwent an enormous increase, especially in the late or neo-agricultural period, and this rendered man in a large degree independent of his teeth, at the same time that it promoted the tendency to disease of these organs. Sound teeth being no longer necessary to life, and the causes of dental disease having greatly increased, it is not surprising that dental disease is now so common. Long before the teeth have an opportunity of being ground down to the roots, or of falling out from sheer old age, they are, among modern peoples, but too often rendered inefficient by caries, pyorrhœa alveolaris, or other causes. So much is this the case that, were we to lose the art of preparing our vegetable food, a large proportion of the people in such a country as our own would, without the dentist's help, either have to become almost wholly carnivorous or perish from starvation.

The masticatory capacity of the edentulous.—People who have no teeth at all are often better able to masticate than those with a few only, for in the former case the gums are allowed to come together and harden, enabling them to cope with many kinds of food, whereas if the mouth is furnished with teeth, no two of which are opposed, they are useless for purposes of mastication. Sometimes, indeed, a single tooth, by preventing the gums from meeting, may render mastication impossible.

Crusts and hard biscuits may present some difficulty to the edentulous, but one which is readily overcome by soaking them in tea or coffee. The toothless should however be encouraged to retain all their starchy food in the mouth as long as possible, and to work it about, so as to mix it thoroughly with the saliva. Though a good deal of the animal food can be tackled, it is generally found advisable to mince the meat.

Artificial dentures for the aged.—It has been suggested that the senile shedding of the teeth is an indication for a return to the diet of the toothless infant, and that the use of artificial teeth by the aged is apt to do harm by encouraging them to take foods unsuited to their years; but though this argument seems plausible enough *prima facie*, when examined critically it will be found, like so many other plausible arguments, to have no basis in fact. If senile edentulism has any biological meaning at all, it indicates, not that nature desires a return to the diet of infancy, but rather that the time has come to cease eating altogether and to lie down and die; for, as we have seen, under natural conditions edentulism implies death from starvation.

Properly fitting dentures cannot but be of advantage to the aged. Modern cookery has rendered it quite as easy for unsuitable food to be indulged in by the toothless as by others, whereas artificial teeth may be of great service by promoting the adequate mastication of the harder forms of desirable starchy foods.

The period between partial and complete edentulism may be one of considerable difficulty as regards mastication, and here the dental surgeon can be of great help: directly the teeth begin to fall out they should be replaced—one by one, if need be—by artificial ones. This is advisable not only for the purpose of maintaining masticatory efficiency, but also because in this way the mouth is enabled gradually to become adapted to the artificial dentures. If the patient waits until he has lost most or all of his teeth before resorting to artificial ones, he will have to pass through a period—perhaps a long one—of masticatory inefficiency, and in the end he may find it difficult, if not impossible, to accustom his mouth to them.

The ideal dietary.—The most suitable diet for the aged is that which constitutes the ideal diet for man in general. Such a dietary demands (*a*) moderation in quantity, (*b*) simplicity in quality, and (*c*) the avoidance of those starchy foods which are apt to slip into the stomach without having been first adequately insalivated.

(*a*) Moderation. A moderate diet is one just sufficient (supposing the various food-stuffs—fats, proteins, etc.—to be properly balanced) to maintain a person at the lightest weight consistent with the most perfect health of which he is capable. It is manifest that any food over and above this sufficiency can do no good and may do harm.

(*b*) Simplicity. By a simple diet is meant one consisting of such items as bread, plain biscuits, plain puddings, plainly cooked vegetables, fruit, meat, bird, fish (all plainly cooked), milk, butter, cheese (such as Cheddar), tea, coffee, cocoa, salt. Dishes calculated to tickle the palate are *not* included in the simple diet. A simple diet excludes alcohol and all condiments other than salt and, occasionally, pepper and mustard.

(*c*) Avoidance of soft starchy foods. All through life starchy foods should, as far as possible, be taken in a form compelling thorough mastication. Soft starchy foods, such as puddings, are only admissible on condition that they be thoroughly masticated.

It is worthy of note that the diet of early man conformed to these three requirements. It was simple, consisting as it did of unprepared animal and vegetable substances; the quantity was not on the whole in excess of physiological needs; and all the starchy food being raw, it had to be abundantly masticated in order to break up the non-digestible cellulose framework and thus liberate the contained food-stuffs.

When we come to compare the ideal with the actual in the present day, the contrast is sufficiently discouraging. Too often stomach and bowel are burdened with an excess of food, and harassed by a too great variety of it. Efficient digestion is rarely possible under these circumstances, and consequently the blood is surcharged with nutrient matter, much of which is in an imperfectly digested form. The tissues being thus bathed in an over-rich and perverted plasma, metabolism fails to proceed normally, and health suffers.

In order to show the application of these remarks to the subject in hand, it may be well briefly to survey the changes which the food undergoes in its passage through the body. These changes may be considered under three phases: digestion (i.e. the conversion of the ingested food into nutrient plasma), metabolism (i.e. the nutritive changes which the absorbed food undergoes in the tissues), and excretion (i.e. the removal of waste-products).

These three functions, as we may term them, are most vigorous in youth and early adult life. Then it is that digestion is most vigorous, metabolism most active, and excretion most efficient. At forty, or thereabouts, the digestive function often begins to show signs of failure, and greater care has to be exercised in the selection of food than was before necessary. Apart from this there is now a greater disposition to prudence—the recklessness of youth tends to depart with maturer years. Young people who have unrestricted choice of luxurious foods are very apt to upset themselves: the "stomach-ache" of Christmas time is as proverbial as the "dose" which follows it. This dietetic imprudence may survive childhood, adolescence, early adult life, nay, it may persist into old age, but most people have acquired some sort of dietetic wisdom by the time they have reached middle age.

At this period not only does digestion often begin to lose its former vigour, but metabolism also shows signs of flagging; the vital fire no longer blazes as it did in the days of youth. Consequently the products of katabolism are not burnt off as readily as they used to be, and if excretion is defective they may accumulate and cause trouble. As yet, however, excretory activity does not show any decided signs of waning.

With the gradual onset of old age there is a further waning of digestive and metabolic activity, in consequence of the degenerative changes which are set up in the tissues. With the digestive organs showing an appreciable increase in their fibrous elements and a corresponding atrophy of their epithelium, it is not surprising that digestion should lack its early vigour. Similar changes are observed throughout the tissues generally, and there is a corresponding sluggishness of metabolism—the vital fire, which has long since ceased to blaze, now smoulders feebly, less oxygen is absorbed and less carbonic acid given off. Except in the case of definite disease of the excretory organs, it is doubtful whether the aged suffer in any marked degree from their inefficiency.

Inasmuch as after early adult life there is a steady waning in the ability of the organism to digest and metabolise the food taken, it follows that the need to conform to the requirements of the ideal dietary becomes with advancing years increasingly pressing. In early life the majority of people can cope with a dietary which departs widely from the ideal—they are able to consume with comparative impunity not only far more food than is required, but also all sorts of foods which in later years cannot be tolerated. We say with "comparative impunity," because chronic dietetic delinquencies, even in early life, cannot but be harmful in the long run, although an occasional lapse from a severely correct diet may, in the case of the habitually abstemious, be actually beneficial, and this even after middle life.

Respecting the capacity of the organism to cope with different kinds of food, the influence of custom and of idiosyncrasy, as well as of age, has to be reckoned with.

As to the first of these influences—while one should be cautious in recommending to an aged person a diet very different from that to which he has for many years been accustomed, the experience derived from prisons, workhouses, and similar institutions shows that the ability of the aged to adapt themselves to novel kinds of diet is by no means small. It is, indeed, astonishing what can be achieved in this direction if the necessary pressure can be brought to bear. Unfortunately in private practice this is not often possible, but if we can only secure his co-operation we may often succeed in getting an aged person to tolerate a dietary very different from that to which he has accustomed himself.

The factor of idiosyncrasy is an important one. Individuals differ greatly, quite irrespective of age, in their digestive and metabolic capacities. We meet with children who are unable to tolerate foods which old people can digest quite easily, and, again, with others who are made ill by even a slight excess, while their grandparents can perhaps consume a large excess with comparative impunity. Some old people have, in fact, prodigious powers of digestion and metabolism, and we may look upon them as corresponding, in the physiological sphere, to the Shakespeares and the Newtons in the realms of mind: they are physiological geniuses. Most of these remarkable old people would doubtless enjoy better health, be more amiable and have greater consideration for others, on a more abstemious diet; nevertheless, in regulating their food we must make due allowance for their prodigious powers.

It may be observed in passing that the capacity to cope with an excess of food differs in different races. The Jews appear to be pre-eminent in this respect, possibly because for longer than any other people they have been able, by reason of their prosperity, to obtain an habitual excess of food, and have in this way become racially adapted to it.

Those who even in early life are feebly endowed in respect of digestion and metabolism, are, continuing our former comparison, physiological imbeciles. The wiser among them soon find this out for themselves; others only learn the lesson late, and even if they learn it, may be deficient in prudence and unwilling to forego the immediate pleasure of indulging in what are for them at least indiscretions. This class of patient offers the physician fruitful scope in the matter of dietetic treatment.

Making due allowance, however, for the personal element, our rule obtains, that while all should endeavour to conform as far as possible to the ideal dietary, allowing themselves no more than an occasional excess, it becomes with advancing years increasingly necessary for the majority of people to eat moderately of simple foods, and not to swallow starchy foods without having first insalivated them thoroughly. If we add to these rules the further ones that old people should take full advantage of dental surgery, that in the case of the toothless, certain of the tougher varieties of food should be broken up mechanically before being taken, and finally that due regard should be had to the influence of idiosyncrasy and habit, we have said all that is worth saying concerning the diet of the aged.

Only in the case of the very feeble is it needful to predigest the food, though material help may often be got from the administration of amylolytic and peptic ferments.

The dietetic indiscretions of the aged.—Some people, unfortunately, and more especially men, tend as they get older to care more and more for the pleasures of the table. As the mental horizon narrows and other interests wane, the subject of the daily meals is apt to bulk larger and larger in their thoughts, until it may become the dominant interest in life, and the daily planning of the meals assume the importance of a great event. All are familiar with the rotund bald-headed old gentleman met with in a certain class of hotel, who appears to have some difficulty in killing time between meals, but rarely fails to turn up when they are due, and then consumes much more food than is good for him.

Though some gourmands of this description manage to dispose of their excess fairly satisfactorily, most of them would enjoy much better health, and get far more pleasure out of life, if they ate and drank in accordance with their physiological requirements, for their excesses generally lead to a long train of disagreeable symptoms, such as irritability, depression, pains, and not infrequently to serious disease.

By restricting the diet in cases of this kind to within reasonable limits, we can often effect a great improvement in health. In order to enlist the co-operation of our patients we should endeavour to bring home to them the gravity of their physiological delinquencies. If, for example, we find a man of 65 or 70 consuming as much food as, or perhaps even more than, he did forty years previously, we should explain to him the folly of expecting his senile tissues to cope with an excess of food as successfully as in the heyday of their youthful vigour.

In no class of case can more good be got from dietetic restriction than in the bronchitis of the aged, and especially when this affection is complicated by obesity. A large number of these patients are allowed to die through non-enforcement of strict rules of diet. It is not merely that over-eating begets bronchitis: the bronchitis, and the emphysema which goes along with it, curtail the respiratory capacity, and so prevent the excess of food from being burnt off. In cases of this kind life can often be prolonged for many years simply by restricting the total quantity of food taken. The only hope of saving the obese bronchitic patient is by systematic semi-starvation, while in cases of acute bronchitis, whether in the old or young (but especially the former), this plan should always be adopted.

Another class of elderly or aged patient greatly benefited by the cutting down of the diet is that in which there is high arterial blood pressure, in conjunction with flushing, giddiness, and perhaps epitaxis. If a patient of this kind has been over-eating we can, unless advanced granular kidney be present, practically always greatly improve his condition by curtailing the diet.

In contradistinction to the usual view, we hold that for elderly and aged gourmands it is generally even more necessary to cut down the allowance of starch and sugar than of animal food, though this should of course also be curtailed if excessive. It is especially in those cases in which the patient, besides partaking liberally of animal food, has been indulging freely in starch and sugar, that we can do most good.

The dietetic instincts of the aged.—Though doubtless the appetite for plain food tends to lose its keen edge with advancing years, and the dietetic instinct—the liking for different kinds of food—to alter somewhat, the changes in these respects are often less marked than might perhaps have been expected.

The appetite for plain food may last to extreme old age. We have found from inquiry at several workhouses that the aged inmates have, for the most part, right good appetites for the simple fare provided, and that their dietetic instincts are much the same as those of their younger companions.

At one of our large London workhouses the daily diet for men over 60 years of age is as follows: bread [1] 20 oz., margarine 1 oz., sugar 1 oz., meat 4 oz., potatoes 8 oz., greens 4 oz., pudding once weekly, stewed fruit once weekly. Tea 2 pints. Salt and pepper daily, mustard once a week. No alcohol.

It must be admitted that this is an ample allowance, probably in excess of actual requirements. Nevertheless, most of the inmates, even the very old ones, consume the whole of their portion and appear to enjoy it thoroughly. The toothless among them seem to manage quite well; the bread crusts they soak

[1] The bread is made from corn ground on the premises; most of it is from "whole-meal," but a small portion consists of two parts of white flour and one of whole-meal.

in their tea, and the meat is generally, though by no means in every case, minced for them.

It is noteworthy that these old people complain very little of indigestion, and—what is even more surprising—suffer little from constipation. Thus in one large workhouse each inmate gets on an average no more than three doses of aperient in the year. Doubtless this comparative absence of indigestion and constipation is to be explained by the simplicity and good quality of the food provided, by the clock-like regularity of the daily routine, and by the high hygienic standard prevailing in the workhouse.

Perhaps the most notable change which the dietetic instinct undergoes with advancing years is expressed by the gradual curtailment of starchy and sugary food during early and middle adult life. Most children are very fond of sugar and cakes, but this liking often suffers a marked diminution when adult life is reached. This is more noticeable in the man than in the woman, probably because alcohol and tobacco—which are more liberally indulged in by the former—tend to diminish the liking for sweet things. After middle life the saccharides are often still further cut down: the "sweet" becomes the least welcome part of the meal and is frequently passed by. This arises partly from disinclination, but largely because an abundance of saccharide food is found to disagree, causing acidity, flatulence and other unpleasant phenomena, such as lumbago and arthritic pains. It must not, however, be assumed that saccharides are in themselves necessarily injurious. It will often be found that those with whom they disagree not only indulge liberally in animal food, but take very little exercise. By curtailing the one and increasing the other, their tolerance of saccharides may be considerably augmented. We have been assured that the aged inmates of workhouses are very fond of sweet things.

THE FEEDING OF INFANTS AND CHILDREN IN HEALTH

CHAPTER XXVI

THE FEEDING OF INFANTS AND CHILDREN IN HEALTH

By G. A. Sutherland, M.D., F.R.C.P.

The great difficulty in connexion with the question of diet in adult life is that we have no authoritative standard which will command general acceptance. For infants, on the other hand, we have both **a standard diet** and a food supplied by nature in **the shape of breast milk**. Experience has shown that this natural food for infants is also the best food, and further that when artificial feeding is called for, the more closely the food approximates to breast milk, the better will be the result. Breast milk is becoming more and more of a luxury for infants, at least amongst certain sections of the population, and the unanimous voice of the medical profession on the importance of breast-feeding is but too little heeded. Nevertheless the young practitioner, however diffident he may be on other subjects, is fully justified in dogmatically asserting the immense importance and necessity of breast-feeding for the welfare of the infant. It is a matter on which the medical profession has made up its mind once for all. Certain cases arise in which breast-feeding cannot be carried out and some artificial food must be used. Here again experience has shown that fresh cows' milk, suitably modified so as to resemble breast milk as closely as possible, is the best substitute at present known. Its use, however, is accompanied by many difficulties and dangers unknown in connexion with breast-feeding. In other cases, where the supply of breast milk is deficient, it is beneficial to supplement this source of supply with a certain number of meals composed of cows' milk. This is known as mixed feeding. These three methods, breast-feeding, mixed feeding, and feeding with cows' milk are the ones in common use in this country and we shall now consider them more in detail.

I. BREAST-FEEDING

Breast milk.—Milk when freshly drawn from the breast is a warm, sweet, sterile, alkaline fluid with a specific gravity of about 1030. The chief solid ingredients,[1] which amount to 13 per cent, are **proteins** (1–2 per cent), **fat** (3–4 per cent), **sugar** (5–7 per cent), and **salts** (about 0·2 per cent). While the fluid part (87 per cent). of milk is most essential to the infant, it may be disregarded at present as not possessing any properties other than those of water. The solids on the other hand are the chief tissue builders, and the source of heat and energy. For the proper growth and development of the infant a certain proportion of each of these solid constituents must be present. For the growth and repair of tissues, proteins and mineral salts are essential; for the production and storage of heat, fat is necessary; and the source of energy lies in the sugar. The proteins are in the form of caseinogen and lactalbumin, the fat is represented by cream, and the carbohydrate present is milk sugar. Breast milk contains these substances in the proportion which is best suited to an infant's digestive powers, which with the large demands of a growing child are to be kept fully employed but must not be overtaxed. The proteins are much more digestible than those of cows' milk which form dense hard curds, and consequently protein-indigestion is not a common trouble in breast-fed infants. The fat is in the form of a fine emulsion which as a rule is easily digested and absorbed. The sugar is very easily absorbed, and is seldom the cause of any gastric disturbance. There is considerable difference of opinion as to the exact chemical composition of milk, and both the nature of the proteins and the effect produced on them by the acids and ferments of the stomach are not yet thoroughly understood.

The **quantity of milk secreted** by the breast varies according

[1] The term "composition of milk" refers to the chemical composition as far as it can be ascertained. There are of course many other ingredients, organic compounds, etc., which have not been determined, but which play an important part in the human economy.

to the requirements of the infant. The secretion is not established usually until the third day after parturition. It differs for a few days from the normal standard and is called colostrum. The colostrum contains some special protein substances, and is also supposed to act as a laxative. The amount of milk is gradually increased to meet the requirements of the child. The following estimates by Pfeiffer as to the daily amount are quoted from Holt.

	Oz.	Grms.
At the end of 1st week	10–16	300– 500
During the 2nd week	13–18	400– 550
,, 3rd ,, ...	14–24	430– 720
,, 4th ,, ...	16–26	500– 800
From the 5th to the 13th week .	20–34	600–1,030
,, 4th ,, 6th month .	24–38	720–1,150
,, 6th ,, 9th ,, .	30–40	900–1,220

With this may be compared the amounts required as estimated by Feer (quoted by Hutchison).

At the end of 1st week	291 grms.
During the 2nd week	549 ,,
During the 3rd week	590 ,,
During the 4th week	652 ,,
From the 5th to the 13th week . .	687–828 grms.
From the 4th to the 6th month . .	893–980 ,,

The rapid increase in the amount secreted during the first few weeks of life is very striking, but corresponds with the rapid growth of the infant at that period.

Variations in breast milk.—The chemical composition of breast milk, after the first week, does not appear to vary much during the normal period of lactation. Although the composition of breast milk has been given above, it must not be considered that an absolute standard has been fixed. As a matter of fact breast milk is constantly varying from day to day in the same woman, and even from hour to hour, under the same conditions of life and diet. Nature has fixed her own limits and the lesson to be drawn is that any artificial food should be within those limits also, but need not be of an absolutely uniform chemical composition. Even at a single nursing the milk at the beginning is often different from that at the close, so that an infant at the breast obtains not only a food but a meal which may be regarded as a series of courses. In artificial feeding therefore the same principle may be acted on and we may vary the composition of the food at the different feeding times, as long as the limits established by nature are not departed from. Too frequent suckling increases the solids in the milk and is thus a frequent cause of indigestion. The indigestion induces pain and crying, and the breast is given still more frequently, with disastrous results. The habits of life of the mother as regards exercise, diet, and alcohol have an important influence on the quality of the milk. It is generally agreed that the fatty element in the milk is the one chiefly affected by diet. The amount of fat can be increased by a full protein diet, composed of beef and mutton, fish, eggs, etc., while it can be diminished by a carbo-hydrate diet composed of vegetables, fruits, and farinaceous puddings. If a woman undergoes a course of stuffing with food and at the same time takes no exercise, the protein element in the milk tends to increase. The quantity of the milk will vary with the amount of fluid drunk, and the proportion of solid contents may be regulated to a certain extent by the fluid intake.

Hutchison quotes experiments of Baumm and Illner as to the effects of various diets on the milk of nursing mothers. They employed the following diets: (1) An abundant mixed diet, (2) a highly nitrogenous diet, (3) a diet rich in carbo-hydrates and fats, (4) a very fluid diet, (5) an ordinary diet with two to three pints of lager beer daily, and (6) a diet with much salt fish, pickles, and other salt foods. The result was that fat was the only ingredient of the milk on which the diet produced any appreciable effect. The amount of fat was sometimes increased 1 per cent on the first and second diets only. This may be regarded as the chemical side of the question, but one must also consider what may be called the biological aspect. Experience has shown that a healthy mother will probably rear an infant with much less trouble than one who is in a weak state of health. The diet and habits of the mother are therefore of the first importance in maintaining her health at the highest possible level, especially considering the extra strain which suckling imposes on her system. The mother's diet should be a mixed one, plain well cooked food being partaken of three times a day. It is not necessary to make any great change in her usual dietary supposing that to have been of an ordinary character. Fresh cows' milk and oatmeal porridge or gruel are always to be recommended as part of a nursing woman's diet. All highly spiced or seasoned dishes which would tend to impair her appetite or digestion should be avoided, but within these limits she should be allowed freedom to consult her own tastes. Her appetite will usually be increased during the nursing period and is the best guide as to the quantity she should take. No stuffing with food, which will probably lead to digestive disturbances, should be practised. As regards increasing the amount of her milk, should this be advisable, the addition of one or two pints of fresh cows' milk to her dietary will be the simplest and most efficient method.

It is popularly believed that the addition of alcohol to the diet, in the form of stout or beer or wine, is beneficial in improving the quality of the milk, as some say, and in strengthening the mother for her extra duties, as others think. This phase of the alcohol question is met by certain writers with the statement that as alcohol cannot be distilled from breast milk, even when considerable quantities of alcohol have been taken by the mother, the effect on the quality of the milk is nil. Holt as the result of some experiments found that the quality of the milk was altered and the quantity increased by giving nursing mothers an alcoholic extract of malt. The alteration in the milk consisted in an increase of the fat and to a less extent of the proteins. Probably exactly the same result would have followed the use of malt extract without the alcohol. Physicians generally have been led by experience to refrain from ordering alcohol during lactation either for the benefit of the mother or the improvement of her milk. If, however, the mother has been in the habit of taking alcohol in moderation, such as is represented by a glass of beer or stout or claret or port twice a day with meals, there seems no scientific justification for forbidding it. The practice by those not accustomed to alcohol of taking it freely during lactation will probably prove deleterious to both mother and child, and should be strongly condemned.

Variations in the quality of the milk during menstruation have not been determined chemically, and as a rule no bad effects can be traced clinically. In some cases it may be found that the infant suffers from convulsions or diarrhœa when the mother is menstruating, and only at those times. If any such disturbances occur one will naturally adopt some other method of feeding during menstruation. As a rule menstruation is not to be regarded as an indication for stopping nursing. The occurrence of pregnancy during lactation does not necessarily change the character of the milk or injuriously affect the child. On the other hand it is very questionable whether a woman can successfully perform the double function at the same time. In exceptional cases she may, but as a rule it is advisable to cease nursing if pregnancy occurs.

Worry, anxiety, and mental distress of any kind may so alter the milk as to render it unsuitable for an infant, as shown by digestive disturbances. Acute bodily illness in the mother will often necessitate the cessation of suckling. If such illness be brief and without after effects it may be possible to carry the infant through this period by artificial feeding and resume the breast-feeding later. During the acute illness the milk should be drawn off regularly by a breast pump. In the presence of constitutional disease on the part of the mother, such as tuberculosis or syphilis, it is not advisable to encourage breast-feeding. If on the other hand the infant is born with signs of active syphilis, there is no reason why the mother should not suckle it provided she is herself in a healthy state.

Wet nursing is not a popular institution owing to the many drawbacks attending its use. At the same time when the breast milk of the mother fails, and the best possible food seems necessary, there is no substitute equal to the milk of another woman. Sometimes, also, after a trial of artificial feeding without success or for an infant debilitated by acute illness the best method of treatment is by wet nursing. A wet nurse should be a healthy young woman of between twenty and thirty years of age, with an infant of about the same age as the one she is to nurse. The milk ought to be analysed in order to see that it conforms to an average standard. Her own infant, if alive, must be healthy and present no evidence of constitutional disease. The wet nurse must also be protected from possible infection through the infant she is to nurse. If syphilis be suspected or be definitely present in this infant wet nursing is not justifiable.

II. FEEDING WITH COWS' MILK

Cows' Milk.—In the absence of breast milk, the substitute which has gained universal acceptance and approval is pure, fresh, cows' milk. It is not however to be regarded as a perfect substitute, and while one may usually look forward to a placid career, free from digestive troubles, for a breast-fed infant, the child who is started early on cows' milk will probably encounter many troubles in connexion with the digestive organs. Cows' milk is meant primarily for the calf, and amongst other features its composition is such as to suit the rapid growth and activity of that animal. This explains the richness of cows' milk in proteins and mineral matters (Hutchison). A calf doubles its weight in the first forty-seven days of life while an infant takes four times as long. The following table shows the differences between average breast milk and average cows' milk.

	Woman's Milk (fresh).	Cows' Milk (fresh).
Reaction . . .	Amphoteric (more alkaline than acid).	Amphoteric (more acid than alkaline).
Water . . .	87 to 88 per cent.	86 to 87 per cent.
Mineral matter .	0·20 per cent.	0·70 per cent.
Total solids . .	13 to 12 per cent.	14 to 13 per cent.
Fats	4·00 per cent. (relatively poor in volatile glycerides).	4·00 per cent (relatively rich in volatile glycerides).
Milk sugar . .	7·00 per cent.	4·75 per cent.
Proteins . . .	1·50 per cent.	3·50 per cent.
(1) Caseinogen .	$\frac{1}{3}$ to $\frac{1}{2}$ of total proteins.	2·66 per cent.
(2) Whey-proteins	$\frac{2}{3}$ to $\frac{1}{2}$,, ,,	0·84 per cent.
Coagulation of proteins by acids and salts	With great difficulty. Curds small and flocculent.	With less difficulty. Curds large and tenacious.
Coagulation of proteins by rennet	Do not coagulate readily.	Coagulate readily.
Action of gastric juice	Proteins precipitated but easily dissolved in excess of the gastric juice.	Proteins precipitated but dissolved less readily.

—From Rotch's *Pediatrics.*

The **differences between the two milks** call for careful examination for certain modifications of cows' milk, based on these differences, have to be employed. The great problems of infant feeding centre around the question as to how these modifications may be most satisfactorily carried out. We shall first consider the differences in the two milks, and then pass on to the modifications in common use. The specific gravity and the amount of water are practically the same in the two fluids.

(1) **The proteins.**—The proteins in breast milk amount to about 1·50 per cent, while those in cows' average 3·50 per cent. The excessive amount of protein in the latter is an important difference, and calls for reduction in artificial feeding. Both milks contain caseinogen and lactalbumin, but while in cows' milk the caseinogen markedly predominates, in breast milk the proportions of the two are nearly equal. As lactalbumin is a much more digestible protein than caseinogen the difference is an important one. Further the caseinogen of the two milks reacts differently to acids, the curd formed by breast milk being soft and flocculent, and soluble in excess of acid, while that of cows' milk consists of large masses which do not easily dissolve in excess of acid.

(2) **The fat.**—The chief difference between the two milks as regards the cream is that fat globules of breast milk are smaller and form a finer emulsion than those of cows' milk. Hutchison states that the fat in breast milk has a lower melting point and is therefore more easily digested. The amount of fat in average breast milk is 4 per cent and in cows' milk 3·75 per cent.

(3) **The carbo-hydrates.**—In both milks sugar is the carbohydrate but there is from 2 to 3 per cent more in breast than in cows' milk. The amount of sugar in the latter must be increased to bring it up to nature's standard. In both cases lactose is the sugar present.

(4) **Breast milk is sterile**, and as it passes direct to the infant there is no opportunity for contamination with microorganisms. **Cows' milk**, on the other hand, as commonly employed is invariably **infected with many organisms** which develop in it with great rapidity. These organisms may be pathogenic or nonpathogenic, the latter however considerably altering the quality

of the milk. The pathogenic organisms are the tubercle bacilli, derived from tuberculous cows or deposited in the milk during transit, and those of typhoid fever, scarlet fever or diphtheria, from infected water, utensils, or hands with which the milk has been brought in contact. These are accidental contaminations and are by no means necessarily present in cows' milk. The observation of proper precautions as regards the health of the cows and of those dealing with the milk, and of cleanliness in the whole management of the milk supply, will serve to prevent such contamination. Unfortunately the necessary precautions and cleanliness are but seldom observed, and many modifications of milk have been adopted to meet this danger. The non-pathogenic bacteria are chiefly of the lactic acid forming group which cause the souring of milk by their action on the milk sugar. These and other organisms reach the milk during the time the milk is exposed to the air or from infected vessels in which it is placed, and increase with great rapidity. Under present conditions it seems impossible to exclude them altogether, and our efforts must be directed to keeping down their numbers as much as possible. Holt states that in one of the finest dairies in America, a Walker-Gordon farm, it was found possible to limit the number of bacteria present in the milk to an average of 5,000 per cubic centimetre at the end of sixteen hours. The bottled milk from high-class dairies was found to contain from 10,000 to 100,000, while from mixed dairies the milk in cans was found to contain from 100,000 to 400,000 bacteria per cubic centimetre, the latter estimate being often reached in very hot summer weather. It is plain that no modification will render such milk a proper food for infants. The question is rather one for the public health authorities, who should regulate the sale of milk in such a way that milk containing more than a certain number of bacteria would be declared unfit for human use.

(5) A certain amount of **coarse contamination** is present in cows' milk which does not occur in breast milk. This takes the form of hairs and surface filth from the cows, of dirt from the hands of the dairy workers, and of dust which is deposited during the exposure of the milk. A certain amount of this can be and ought

to be removed by filtering through fine cloth, as it is by no means a desirable addition to the milk. In the best dairies the amount of contamination is much reduced by the observation of strict cleanliness in the whole process of milking and the immediate storing of the milk in airtight vessels.

(6) **Human milk is alkaline**, while the reaction of **cows' milk is acid**, and the acidity increases with the formation of lactic acid. It is probable that the slight degree of acidity present in cows' milk is not of great importance, as gastric digestion is carried on in an acid medium, and the salivary secretion is slight. If the milk is soured by the excessive development of lactic acid, it is not fit for use. The practice of adding an alkali simply to render cows' milk alkaline has rather fallen into disuse in the feeding of healthy infants. The addition of lime-water as a routine proceeding is not to be recommended as cows' milk contains normally a large amount of lime salts.

(7) **Mineral matter**. There is from three to four times as much mineral matter in cows' as in breast milk. The chief salts are those of calcium and phosphorus. Hutchison states that in human milk nearly all the phosphorus is in organic combination, while in cows' milk less than half is. Calcium salts are much more abundant in cows' milk than in breast milk, and this difference has an important bearing on the question of protein digestion, as will be seen later.

Modifications of cows' milk in infant feeding.—It may be stated as a generally accepted axiom that the more closely the artificial diet of an infant approaches in composition that of breast milk, the more likely is it to be a successful substitute. Certain modifications are called for in connexion with cows' milk in order to secure this object. We shall now deal with these, taking first those which are simple and easily carried out at home, and next those which are more elaborate and require skilled supervision. It will be necessary to consider the effect of these modifications, and whether the avoidance of certain dangers may not be accompanied by a tendency to others. For example, the sterilization of cows' milk in order to prevent the danger of tuberculous infection may remove entirely from the milk the quality of freshness or vitality in which lies its antiscorbutic property. The questions raised are not purely chemical ones and cannot be determined by laboratory experiments ; they are also biological and can only be settled by testing them on many infants over prolonged periods. At present there is no consensus of opinion as to the best modification of cows' milk, and each writer on the subject must be guided to a large extent by his own experience. He should also pay due attention to the experiences of others with different methods, and should write without dogmatism.

(1) The essential **difficulty about cows' milk** lies in the quantity and quality of its **protein matter. Dilution with fluid** is the simplest manner of reducing the quantity to the standard of breast milk, while as a matter of clinical experience the quality of the proteins is not found to require modification in the case of healthy children. It is different with delicate or ailing infants, who will be considered later. For the first fortnight of life the dilution may be of the strength of milk : diluent as 1 : 3, and then on to the age of three months 1 : 2. From the age of three to six months, equal parts may be given, and from six to nine months two parts of milk to one of diluent. The diluents in common use are plain water, barley-water, and lime-water.

Plain water may be used, either boiled or unboiled, according to the purity of the water supply, but as a rule custom dictates some other diluent. Barley-water has come into very common use. It is supposed to diminish the density of the milk clot formed in the stomach and thereby to make digestion more easy. The nutritive value popularly attached to it by mothers is mythical, for if properly prepared, barley-water will contain less than 1 per cent of starch. It should be prepared as follows : A tablespoonful of pearl barley is washed and put in a saucepan with one pint of cold water. This is brought to the boil and then allowed to simmer beside the fire for half an hour. The water is then strained off and used as required. Barley-water should be prepared twice daily as it does not keep well. Strong decoctions of barley, or those made from ground barley, are not to be recommended for infants until after the age of nine months. Before that they are the cause of much intestinal disturbance as the digestive apparatus for starch is not sufficiently developed. The

48

chief benefits in using barley-water are that it is a bland fluid, less irritating to the stomach than tap water, and that as it has been boiled the fluid is sterile. Lime-water is also less irritating in the stomach than plain water. The lime has probably a slight effect in delaying the curdling by the acids in the stomach, but its antacid power is very feeble. It may be used quite safely as the regular diluent, but as a rule is better reserved for cases with gastric disturbance.

(2) The dilution of the milk renders the **addition of some fatty matter** necessary, as the fat has been reduced to one-third the amount in breast milk by the addition of two parts water. It is often advisable, however, to begin bottle feeding in the first week without the addition of any cream, as the fatty material so often causes digestive disturbances. One can thus ascertain first of all whether the protein contents of the artificial food are going to be well tolerated by the infant, and can add the fatty material in gradually increasing amount as toleration is established. Digestive disturbances are but too often started by the tendency to feed up an infant from birth, which usually means overfeeding, and the tendency to give an excessive amount of fat at this age is specially marked. The extra fat is usually added in the form of cream, butter, or cod-liver oil. A pint of good cows' milk will yield from 1½ to 2 oz. of gravity cream. Gravity cream contains from 15 to 20 per cent of fat and the same amount of proteins and sugar as the milk. If 7 oz. of milk diluted with twice that amount of water are used, 1 oz. of cream must be added to the mixture to bring the milk to the proper standard, i.e. 4 per cent of fat. The exact strength of the cream in fat is an important matter and Holt has found by careful experiments that he can get a standard 20 per cent cream as follows. If cows' milk from a mixed herd is put into a pint vessel soon after it is drawn and rapidly cooled, it will be found that after four hours the upper 4 oz. will contain 20 per cent of fat. Unless, however, one is dealing with a milk of known strength it is impossible to estimate the amount of fat in gravity cream with absolute accuracy. Still it serves well enough in ordinary circumstances and gravity cream has the advantages of being digestible and easily made at home in four hours from

fresh milk. Separated cream can be made of any definite strength in fat, although as commonly sold the fatty contents may vary from 40 to 60 per cent. It has the disadvantages of being less easily procured in many places, of being often stale from keeping, and of being less digestible than gravity cream from a change in the fat globules through the action of the centrifuging machine.

Cream is a very expensive luxury for the poor and cannot always be obtained of good quality even by the well-to-do. Butter or margarine may be used in place of it to supply the extra fat. Butter and margarine contain about 82 per cent of fat, i.e. twice as much as separated cream and four times as much as gravity cream. In infant feeding, if butter or margarine is used, one must add one quarter the amount as compared with gravity cream and one half the amount as compared with separated cream. Both butter and margarine are easily digested and possess great nutritive value. If good butter is sometimes rather expensive, the price of margarine places it within the reach of all. Cod-liver oil is a cheap and efficient substitute for cream, and is easily digested by most infants.

(3) The dilution of cows' milk reduces the **amount of sugar** from 4·50 per cent to 1·50 per cent when two parts of water are added. Some additional sugar must therefore be added to bring it up to the necessary standard. Sugar of milk is the best for this purpose in that it is the same as exists in breast milk, but for common use it is too expensive. Maltose in the form of extract of malt may be used as it has stood the test of experience well. Malt extract contains about 50 per cent of maltose, and in addition soluble starch (10 to 15 per cent), proteins (about 5 per cent), ash (1 to 2 per cent), and an important diastatic ferment. It has a marked sweetening power, much more so than sugar of milk, and is easily digested and absorbed by an infant. It not only renders the milk very palatable but will convert any starch present, as when barley-water is added, and is believed to render the curd in the stomach less dense and indigestible. Honey contains from 74 to 78 per cent of invert sugar, which is really a predigested form of sugar and ready for immediate assimilation (Hutchison). It is well suited for infants, who relish it also as

a "sweetener." Fresh honey is to be preferred, and those who keep bees as well as babies should not fail to employ this source of nutriment. Regarding the honey which is bought in shops, one has to exercise some care in securing a pure article, as adulteration is common. The price of honey, about 9*d.* a pound, compares favourably with that of malt extract, which is 3*s.* Cane sugar may also be employed with safety, and although not so digestible as the other forms of sugar, and more apt to produce fermentative disturbances, it usually acts well and has the advantage of being very cheap. The amount of sweetening matter to be added will vary with the age of the infant, but for the first month the addition of ½ oz. of sugar of milk or malt extract or honey, or of 3 drms. of cane sugar, to each 15 oz. of milk as prepared for use will be found sufficient.

(4) The risks of **bacterial contamination** in connexion with cows' milk have led to certain precautions which are not called for in the case of breast-feeding. Those who keep their own cows or who can obtain the milk direct from the cows do not require to take any special measures. Some dairies also—very few in this country unfortunately—will deliver the milk under such conditions of purity and kept at such a low temperature, that the milk may be safely given to an infant without any treatment for the destruction of micro-organisms. Here it may be stated that in all probability fresh pure cows' milk, untouched by heating or preservatives, is the best artificial food for infants. Under the conditions of town life such milk is rarely to be obtained, and we have to consider what means may be safely taken to prevent the development of pathogenic and non-pathogenic organisms in milk. The use of preservatives such as salicylic acid, boric acid, formalin, etc., may be mentioned but only to be condemned. The ingestion of such chemicals, even in small quantities, over a prolonged period may affect the growing infant most injuriously and is certainly not indicated by nature's teaching. Further, the purpose of this method of preservation which is carried out by the milk dealer is not to maintain the purity and freshness of the milk but to prevent it from becoming noticeably bad. As to any weakening of its nutritive power he is entirely careless and is concerned only that the milk should be kept in a saleable condition

by this means. The method then has many dangers and no advantages. What is preferable is that the milk should be delivered as fresh as possible and that the necessary treatment should be carried out at home. In this country the treatment takes the form of raising the temperature of the milk sufficiently high to destroy the micro-organisms present.

The heating must be carried out in such a way as to interfere as little as possible with the chemical composition and nutritive value of the milk. This is best secured by **boiling the milk.** The usual plan is to put the milk in a clean pan and boil it for one or two minutes. The drawback to this method is that it so alters the taste of the milk as to render it unpalatable for some infants. A better plan is to put the milk-containing pan into another containing water and to bring the water to the boil. The boiling should be continued for five minutes, at the end of which the milk will have been raised to the same temperature and should be removed and cooled rapidly. The milk itself has not been boiled because the boiling point of milk is higher than that of water, and thus the change in the taste is not induced. The milk should then be transferred to a clean glass vessel, fitted with a lid, or covered with fine muslin, or plugged with cotton wool, and placed in a cool place, for instance the outside ledge of a window. In hot weather the milk should always be kept on ice.

By this method of heating the pathogenic as well as the non-pathogenic organisms will be destroyed, although some spores may still remain untouched. Possibly some ferments in the milk have also been destroyed. Milk thus treated will undoubtedly "keep" better than unboiled milk, but should not on that account be kept for more than twelve hours, or else the quality of freshness will be lost. It must also be remembered that although boiled milk is sterile, it remains a suitable culture ground for bacteria if exposed to fresh contamination.

A considerable amount of controversy has taken place over the question of the relative digestibility of boiled and unboiled milk. Clinical experience seems to show that there is very little difference. Boiled milk is said to be more constipating than unboiled but this effect is by no means constant. On the whole it may be said that the boiling of milk, especially in hot weather, is a great safeguard and does not injuriously affect the nutritive properties of the food.

REGULATIONS AS TO FEEDING

The number of meals.—The number of feeds in the twenty-four hours must be arranged according to the age of the infant, and the times fixed must be closely adhered to. It is very rarely that one meets with an infant who is not being fed often enough, while one is constantly coming across infants who are being fed much too frequently. The interval between meals should be long enough to allow of complete digestion, and of emptying of the stomach, and of a period of rest for the stomach. As a rule during the first month of life these requirements will be met by feeding every two hours during a day of sixteen hours, i.e. from 7 a.m. to 11 p.m. It is beneficial for the child that during the night of eight hours only one feed should be given, at 3 a.m., thus giving two intervals of four hours for a little extra rest to the stomach. While a minimum of two hours' interval should be insisted on, in the case of healthy children the maximum may often be extended to two and a half or three hours during the day, even in the early weeks of life. If it is found that a child will sleep for this longer period and will then take a feed, without any sign of overloading of the stomach, the individual tendency should be considered rather than any hard and fast rule. It is of extreme importance that the times of feeding, after having been fixed, should be rigidly adhered to. Habit is easily established, in the breast as regards the secretion of milk, and in the infant as regards the desire for food, and much trouble will be spared to mother and child by forming regular habits early. If the infant be asleep when the feeding time comes he should be wakened and fed. If he cries before feeding time he is not to be fed, but an examination should be made as to other causes of discomfort, local or general. A nurse should be able to distinguish between the peevish or irritable cry of discomfort or pain, and the healthy piping with which an infant demands more food. In hot weather more especially a common cause of crying is thirst and not hunger, and to relieve this plain water or barley-water may be given between meals. As the infant grows the intervals between meals should be lengthened and the number of meals diminished. The following table shows approximately the indications as to feeding times in a healthy infant.

NUMBER OF MEALS AND HOURS OF FEEDING FOR BREAST- OR BOTTLE-FED BABIES.

	By Day. (16 hours). Interval.	By Night (8 hours). Interval.	Number of Meals in 24 Hours.
Up to 3 months	2 –2½ hours	4 hours	10–8
Between 3 and 6 months .	2½–3 ,,	4 ,,	8–7
,, 6 ,, 9 ,, .	3 ,,	8 ,,	6
,, 9 ,, 12 ,, .	3½–4 ,,	9 ,,	5

The quantity of food.—A newly born infant should be put to the breast within a few hours, and afterwards at regular intervals. The quantity of nourishment at first may be small but it is sufficient for the purpose until nature increases the supply. The average amounts of breast milk at different periods of lactation have already been given. In any individual case one must judge by the size of the breasts, the ease with which milk is expressed, and more especially by the satisfaction or otherwise of the infant after a feed as to whether a sufficient amount of milk is present. If the infant fails to gain in weight, and is restless and dissatisfied after a meal, without showing definite signs of indigestion, one will naturally feel doubtful as to whether a sufficient amount of milk is present. The exact amount taken may be ascertained by weighing the infant before and after a feed. The best test as to the quantity at a meal is the infant's appetite, for under regular hours of feeding he will usually take as much as is good for him and no more. If he falls asleep while taking the breast he has had enough, and should not be roused to take more. If vomiting occurs soon after a meal he has probably taken too much. Some infants tend to drink the milk very quickly, a habit that must be checked by limiting the rate of outflow through the nipple. If an infant has been from ten to fifteen minutes at the breast, he should usually have obtained a sufficient quantity. The contents of one breast are usually sufficient for a meal, and the breasts should be used alternately.

In the case of **bottle-fed babies** the amount at a feed must be fixed. Here what we have to fix is the maximum and not the minimum. The minimum amount to be taken is to be decided by the infant's appetite at each meal, which will prove the best guide. When a child has had enough it will usually stop and no coaxing should be employed to make it take more. The painful scenes in which an infant is worried to drink more, has the teat pushed repeatedly into its mouth, and finally in despair of securing rest in any other way, sucks down the surplus milk, should not be enacted in a well regulated nursery. It is especially in the case of sterilized or pasteurized milk, when the amount for each meal is supplied in separate bottles, that this evil prevails. Mothers get the idea that a fixed amount must go down at each meal, irrespective of age, size, strength, illness, hunger or thirst. We hold that there is more scientific accuracy in determining the minimum amount a baby should take in that baby's appetite than in any system of feeding which can be devised. Automatically the various influences referred to above, age, size, strength, and special requirements are brought into play in adjusting the appetite so as to meet the demands of the infant. The maximum amount at a feed must be fixed, not according to any general standard but according to the needs of the infant. The amount which different infants of the same age will take varies greatly. We begin with small amounts at first and gradually increase them as toleration is established. When a proper amount has been reached, which will be determined by having regard to the size of an infant's stomach, its age and weight, and when the infant is growing satisfactorily on this amount and is comfortable after a feed, it is advisable to regard this as a maximum. There is no doubt that many infants, under slight encouragement, will swallow down more food than the capacity of the stomach and the powers of the digestive organs will justify. In practice one will often find that this encouragement is but too readily given by the mother who believes in the feeding up process, and is ignorant of the bad results. It is better to be beforehand in preventing these results by fixing the maximum amount at a meal than to have to adopt a long course of curative treatment later. In the present day many babies find themselves classed among those who "cannot take cows' milk." This class is largely composed of those who have been overfed and have broken down under the process.

One must be able to state the approximate amount of food suitable for infants of different ages. In the following table are given the amount of food at a meal, and the proportion of milk and water in the mixture, the estimates being of an average character.

	Amount at each Meal.	Proportion of Milk and Water.
During 1st month	1–1½ oz.	1–3
,, 2nd ,,	2–3 ,,	1–2
,, 3rd ,,	3–4 ,,	1–2
,, 4th ,,	4–5 ,,	1–1
,, 5th ,,	4–5 ,,	2–1
,, 6th ,,	5–6 ,,	2–1
From 7th to 9th month	6–7 ,,	3–1
,, 9th to 12th ,,	8–9 ,,	All milk.

In the next table are given the total quantities of food material in twenty-four hours, with the proportion of each ingredient.

QUANTITIES OF FOOD MATERIAL IN TWENTY-FOUR HOURS.

	Milk.	Plain or Barley-water.	Gravity Cream.	Sugar or Malt Extract.
	Oz.	Oz.	Oz.	Oz.
During 1st month	3–6	10–15	½–2	½–1
,, 2nd ,,	6–8	12–16	2–2½	1–1¼
,, 3rd ,,	8–10	16–20	2–3	1–1½
,, 4th ,,	10–15	10–15	2–3	1–1½
,, 5th ,,	15–20	7–10	2–3	1
,, 6th ,,	20–25	10–12	1–2	1
7th to 9th ,,	25–30	8–10	1–2	1
9th to 12th ,,	30–40	—	1–2	—

Necessarily these are but approximate estimates, but enough has been said above to show that other factors than age must be taken into account. A premature infant will require smaller and more dilute feeds than a full term child. Another point to be considered is the variation in the amount and quality of the food at different seasons. Less food is required during the hot months than in cold weather, as will be indicated also by the infant's appetite. Without reducing the amount of diluent, it will be found advisable in hot weather to reduce the amount of milk and cream, as given above.

It may be said that the amount of proteins in the milk feeds is steadily increased up to the ninth month by a diminution of the amount of diluent, and that in this respect nature's method is not followed. Chemical analysis shows that the proteins of breast milk do not increase in amount as the infant grows; it is only the amount of milk which becomes greater. This criticism may be admitted as correct. If from any reason breast-feeding were suddenly stopped at eight months, one would not put the infant at once on to milk diluted with one-third water. The food would probably be too strong, and a weaker dilution would be ordered. On the other hand when the infant has been fed from the early months with cows' milk of gradually increasing strength, the stomach becomes accustomed to it and digests the food. The difficulty is met by increased digestive action on the part of the stomach which can be carried out, as a rule, without any sign of distress. If the dilution of the early months were kept up, the total amount of fluid required would be in excess of an infant's requirements and would produce dilatation of the stomach.

Bottles and bottle-feeding.—The dangers of the milk are frequently added to by those of the bottle. The old-fashioned flat bottle with long india-rubber tubing attached has now been reformed out of existence. It has been replaced by one of oval shape, with at least two openings, and with a rubber nipple attached at the end. While the cleaning is thus rendered easier it still requires a good deal of skilled attention. The question as to whether all feeding bottles may not be reformed out of existence can be answered in the affirmative. At Paddington Green Children's Hospital, and probably in other hospitals, no bottles are used but the infants are fed out of ordinary feeding cups with rubber teats attached to the end of the spout. The advantages of these over any form of bottle are very great. They can be cleaned with the greatest ease simply by running boiling water through them in a shorter time and with more thoroughness than any form of bottle. In order to allow of cleaning, there should not be a strainer in the neck of the cup. These feeders require, as is right, that the nurse should hold the cup and attend to the feeding throughout the meal. The nipples are of a larger size than were formerly used for feeding bottles. At first sight it might appear likely that some deformity of the mouth might follow from the use of these larger teats, but they really seem to reproduce more exactly nature's method, in which an infant's mouth is filled with the nipple and part of the breast. The rubber teat is removed after feeding, turned inside out, and cleaned in hot water ; it is then kept in cold water until required again. The teats must not be kept too long in use as they soon begin to show small cracks. The feeding cups should be made of china, and not of any porcelain-lined metal, as the lining of the latter tends to chip off and leave an uneven surface which renders thorough cleaning impossible. By these means the risk of the milk becoming contaminated with organisms in the feeding apparatus is reduced to a minimum.

The palatability of the milk mixture.—One desires to make the food palatable to an infant and as varied as possible. The addition of milk sugar or malt extract or cane sugar will usually give the sweet taste which is most appreciated. Some infants will take one of these flavouring agents more readily than either of the others, and this can be found out by actual trial. An infant will have a distinct preference for one flavouring, to which it has been accustomed, and show clearly if that flavouring is not present. It is not advisable to over-sweeten the milk at times or the less sweetened milk may be refused. Although custom has prescribed the use of warm milk for infants, there is no harm, especially in hot weather, in trying a feed of cold milk, and if the child prefers it in continuing the same. Naturally one will not try iced milk or milk just off the ice. Even with the sweetening added there must be a monotonous sameness about an infant's diet, and if any such flavouring as cinnamon water or dill water is liked, there is no harm in mixing a little of one or other of these with the milk. Barley-water as a drink will often be taken better if one of these flavouring waters is added. A slight variety in the diet may be secured by giving one or two cream feeds in the day in place of the ordinary milk mixture, as follows: Gravity cream, ½ oz.; malt extract, 1 drm.; barley-water, 2½ oz. This also varies the work to be done by the stomach inasmuch as the fat digestion is here tested in place of the casein digestion of the ordinary mixture.

III. MIXED FEEDING

In many cases a mother with the best intentions finds herself unable to supply a sufficient amount of breast nutriment for the infant. The defect may be either in the quantity or the quality of the milk. If the infant is always dissatisfied after a meal, always ravenous, and is not gaining weight, an examination of the breast milk is called for. If the quality is up to the average standard, then probably the quantity is at fault. The quantity may be increased by more suitable diet, or if necessary the number of breast feeds may be reduced. If the mother is healthy, the quality can usually be improved by attention to her diet and habits. Other causes may be present which demand some extra supply of food, such as the mother's absence at work, or the state of her health.

In such cases **mixed feeding,** i.e. partly breast milk and partly cows' milk, is to be encouraged. As a rule mothers are quite willing, nay anxious to adopt this method, especially amongst the lower classes. Possibly the present writer may have been unfortunate in his experience, but he has been much impressed by the frequency with which breast-feeding is stopped by medical advice. If there has been the slightest trouble with the infant's digestion, or if it is not thriving well, the first remedy suggested seems to have been to stop breast-feeding. Now, although healthy children can be reared on cows' milk, the infant who has to depend entirely on artificial feeding is heavily handicapped in the struggle for existence. The mortality statistics of breast-fed and bottle-fed infants show this clearly. Consequently it is of the greatest importance to encourage breast-feeding whenever possible and to search for and correct every other possible cause of failure before falling back on the breast milk as at fault and stopping the nursing. A popular prejudice against mixed feeding exists in some quarters, but experience has shown that it can be carried out with perfect safety and success. When mixed feeding is necessary the nature of the artificial substitute must be carefully thought out. In the case of infants under a month one will give a preference to peptonized milk or whey. The disadvantages of these as a whole diet do not apply when breast milk is also being used, and they supply a food very similar as regards digestibility to human milk. Less care in the preparation is required for condensed milk or dried milk, which will usually be well tolerated if given well diluted. After the age of one month cows' milk, modified as previously described, will be found perfectly efficient in most cases. Where special difficulties are met with in connexion with the digestion, the cows' milk must be given in greater dilution or citrate of soda may be added to the milk.

SIGNS OF SUCCESSFUL FEEDING

By many the only test employed as to the success of the diet is the gain in weight. This is too limited a view. An infant may be gaining in weight but may not be thriving. Fat in infancy is easily produced by an excessive amount of carbo-hydrate in the diet, but the nutrition usually suffers. To estimate correctly the progress of a child under a given diet several things have to be noted. The signs of success are:

(1) A steady increase in weight, combined with firmness of the muscles and active movements of the limbs.

(2) A regular and good appetite, and satisfaction after a meal.

(3) An absence of vomiting, and flatulence, and anæmia.

(4) Regular actions of the bowels, with healthy stools.

(5) A condition of comfort and happiness in the infant when awake, and regular periods of unbroken sleep.

If these conditions exist and persist one may usually conclude that the diet is satisfactory, and that illness, near or remote, is not to be feared as a consequence of the food employed. The weighing machine is a curse in many nurseries. The anxious parents hang around to hear the weekly report, and if it is an ounce short of what was expected gloom settles over the household. Probably the nurse has made a mistake in the weighing. The infant's digestive powers may next be overtaxed in the effort to make up lost ground. As a rule, therefore, it is better to avoid weighing machines in private work, and to judge by the appearance of the infant, which will be a sufficient guide to any one with a little experience. The steady gain which is desirable amounts on an average to about 4 oz. per week during the first six months of life.

A CHANGE OF DIET

Before jumping to the conclusion that some other food must be tried for an infant it is extremely important to make sure that the food employed is the element at fault. In the vast majority of cases it will be found that pure milk simply modified will suit the infant perfectly well. A change of diet should not be adopted until the following points have been thoroughly inquired into and corrections made if necessary.

(1) The purity and freshness of the milk at each feeding. If the milk is swarming with organisms, or sour, one cannot expect satisfactory results.

(2) The strength of the milk as regards solid elements. The tendency is to give as rich a milk as possible, to add cream, or some starchy food, in accordance with the popular belief that the stronger the food the stronger the infant. This usually leads to disastrous results as regards digestion and nutrition. The opposite mistake, namely the giving too weak a food, is but rarely met with, but may be the explanation in certain cases where the weight is not being maintained.

(3) The quantity at each meal. Both the feeding up tendency of the mother and the appetite of the infant may require regulating. Overfeeding causes more digestive troubles in early life than all the other causes together. Every cry of an infant is interpreted as being due to hunger, and food is poured in. If

the bottle is not finished readily, much time is devoted to coaxing the infant to swallow more. If vomiting occurs, the next meal is hurried on to make up for the previous fluid and curd lost. Then the physician is solemnly assured that the infant cannot digest cows' milk!

(4) The regularity of the meals. It is essential even in the earliest months of life that a proper interval for digesting a meal should be allowed. The minimum length in health should be two hours. Water can be given between meals to allay thirst.

(5) The presence of local or constitutional disease in the infant. In the case of congenital pyloric stenosis one usually finds that a great variety of foods have been tried but that the disease has not been recognized. In the case of congenital syphilis wasting may have led to a trial of various foods in the belief that the suitable food had not been hit upon. If is of the first importance to make a careful physical examination in every case of supposed food disorder so as to determine the presence or absence of any disease in the infant which may have an influence on the disturbances present.

Were these questions always carefully considered it is our belief that the number of children who are supposed to require specially modified milk would be greatly reduced, and that the infantile stomach would be found to be an organ capable of accommodating itself to the digestion of cows' milk.

OTHER MODIFICATIONS OF COWS' MILK AND SPECIAL FOODS

The more elaborate methods of modifying milk require careful consideration because they represent attempts to overcome difficulties in connexion with this food material. Some of them are of a scientific nature and are based on chemical and bacteriological investigations. Others are of a commercial nature with a pseudo-scientific claim attached to them by the manufacturers. There are two standards by which these preparations must be judged, first as to how closely they approximate in composition to breast milk, and secondly as to their effects, immediate and remote, on the growth and nutrition of the infant. It will be found that in correcting one fault or defect in cows' milk, the result too often is that others are produced. In other words, clinical experience has shown that scientific modifications of milk are not to be relied on as the sole guides in infant feeding. Test tube experiments in the laboratory are not the same as digestive experiments in the human stomach. Chemistry and bacteriology are not enough without considering the biological needs of an infant, and these can only be determined by prolonged observations on a living child.

We have already considered certain modifications of milk which are simple and can be carried out in any household. They have stood the test of experience and may be regarded as leading to the production of a diet which will carry the infant safely through the first nine months of life, and will not tend to ill-health or disease afterwards. There are certain other modifications, more elaborate as a rule, which have been evolved with the object of meeting certain difficulties in connexion with feeding with cows' milk. These will now be considered in detail, attention being directed to the method of preparation, the advantages which are claimed, and the disadvantages which may accompany the use of milk thus modified. We shall deal here only with the use of these modifications of milk in the feeding of healthy children, and shall defer the question of their application to the treatment of diseased conditions to a later section.

1. Sterilized Milk.—There are various methods of sterilizing milk. We have already referred to the sterilizing action of boiling the milk, but by the term "sterilization" is meant the exposure of milk to a temperature of 212° F. or higher for a period varying from half an hour to an hour and a half. By some it is boiled and by others it is treated by steam. It may be carried out at home when a special sterilizer is used, such as Soxhlet's, Arnold's, Cathcart's, etc. The milk may be sterilized in bulk on delivery and afterwards modified by the addition of cream, sugar, etc., or, the necessary dilution and additions having been made, the prepared milk for twenty-four hours is put into bottles, each containing enough for one meal, and all the bottles are put in the sterilizer and heated; the bottles are then put aside on ice and are opened as required. They are usually made so that a rubber teat can be fixed around the opening, and the child fed direct from the bottle.

The advantage claimed is that all organisms, pathogenic as well as non-pathogenic, are destroyed in a much more thorough manner than by boiling the milk for one or two minutes. The object aimed at is to prevent the occurrence of disease by specific contagion in the milk or by fermentative changes in the milk. By some it is claimed that the milk is rendered more digestible, by others this is denied. Hutchison states that sterilization alters the taste of the milk, destroys the fine emulsion of the fat, coagulates the lactalbumin, and renders the casein less easy of digestion. In all probability the digestibility of the milk is not altered to any marked extent. Holt states that the constipating effects of sterilized milk are soon noticed.

The advantage of destroying the organisms in cows' milk has already been emphasized, and sterilizing will effect this object more fully than simple boiling, although certain spores may still resist the effects of the high temperature. Milk which has been sterilized will also keep from souring longer than milk not so treated, but it will none the less become stale. Milk which has been swarming with organisms will not be rendered pure by sterilizing, and the various toxins produced in milk which has already been kept too long will not be destroyed by prolonged heating. There is also a biological aspect to the question. Experience has shown that sterilized milk is apt to lead to anæmia, rickets, and more especially scurvy. Out of 379 cases of infantile scurvy collected in America, the previous diet in 107 cases was sterilized milk. This means that some vital property in fresh milk has been destroyed. Milk which has been sterilized has not only been boiled, it has been boiled to death. So generally has this been recognized that the process is now considerably shortened, and many consider that from ten to twenty minutes is a sufficient length of time. As a complete diet for infants sterilized milk is not to be recommended, and its use might with advantage be reserved for special conditions of ill-health which only the physician can determine. It will be found useful as a temporary resort when milk has to be transported a long distance, or when the suspicion of infection in the milk (typhoid, tuberculosis) renders special precautions advisable. It has no advantage over boiled milk in the prevention or cure of infantile diarrhœa.

Sterilized milk is also supplied by the dairy companies. The same objections which have been urged above apply here, and there are others. The process of sterilization requires skilled supervision, and one can never depend on dairy milk having been prepared according to exact scientific methods. There are but too many opportunities of scamping the work. Again, while one can usually tell as to the freshness of untouched milk, it is impossible to form an estimate as to how many days sterilized milk has been kept and how many times it has been re-sterilized. Sterilization forms an excellent method of preserving for future sale the surplus supply of fresh milk at the end of the day. For these reasons if sterilization is employed it is very much better to carry out the process at home.

2. Pasteurized milk.—In the process of pasteurization the milk is subjected to a temperature of from 158° F. to 170° F. for half an hour or longer. It may be carried out at home in an apparatus specially constructed for the purpose. Milk thus treated will keep sweet for two or three days if stored on ice, the heat employed being considered sufficient to destroy pathogenic organisms although not their spores, and to prevent fermentative changes. Some deny that all organisms are destroyed, and regard the process as incomplete sterilization. If it is desired to secure tubercle-free milk it will be safer to sterilize or boil the milk than to trust to pasteurization. The changes in the taste and in the solids of the milk after sterilization are avoided by the use of the lower temperature employed in pasteurizing.

The objects aimed at in pasteurization are to destroy the organisms in milk, and by means of the lower temperature used to overcome the disadvantages which were found to follow the prolonged use of sterilized milk. The risks of anæmia, scurvy, etc., are said to be avoided. It seems probable that pasteurized milk, which has been properly prepared, is a perfectly safe diet for infants. The temperature should not be higher than 158°

F. and the time not longer than twenty minutes, if the nutritive value of the milk is to be preserved intact. After pasteurization the milk is quite as liable to contamination and fermentative changes as fresh milk, and the same precautions must be taken to prevent fresh infection, e.g. enclosure in air-tight vessels, storage on ice, etc. The exact carrying out of the process will usually require more skill and time than are available in an ordinary household. Cases of scurvy have been reported after the prolonged use of pasteurized milk, but probably the heating had not been properly carried out. It is questionable whether anything is really gained by this process which cannot be more simply secured by boiling the milk.

By many dairy companies milk is now pasteurized in bulk and supplied to customers. So far as my own knowledge of this system goes, it has not been adopted with the view of preserving the customers' health but for the protection of the dairy company against legal liabilities from the sale of infected milk. Stale milk which has been pasteurized may contain many active poisons although few living organisms. Again, as Crozier Griffith has pointed out, while pasteurization destroys the bacteria, the spores of the subtilis group are unaffected. Unless the milk is carefully preserved on ice these spores, unchecked by the presence of living lactic acid germs, will multiply even faster than in raw milk, and may cause severe diarrhœa. In many cases the purchaser is unaware that the milk has been pasteurized and at once boils the milk on delivery. This double treatment of the milk will tend to the production of the drawbacks mentioned in connexion with sterilized milk. In the feeding of infants *it is extremely important that the whole treatment which the milk has undergone before delivery should be known.* The dairy pasteurization of milk may or may not be properly carried out, the milk supplied may or may not be fresh, and the result as regards the infant may or may not be successful. For these reasons the home modification of milk is to be preferred, and a guarantee should be obtained from the dairy as to the state of the milk provided.

3. Laboratory milk.—The most scientific modification of milk which has ever been attempted is that known as the "American or percentage " method. It has been evolved by the genius and enthusiasm of Dr. T. M. Rotch of Harvard. Every precaution is taken which human ingenuity could suggest to render the source of the milk supply as good as possible, and to preserve the milk from contamination during the period between leaving the cow and reaching the infant. As a result of the special method of feeding the cows, the milk has an almost uniform percentage of the solid contents all the year. The process through which the milk passes is a somewhat prolonged one, consisting of separation, recombination according to the physician's prescription, bottling and sterilizing. The modifying materials are kept for use in glass vessels at a temperature of 40° F. to prevent the growth of bacteria. The milk is delivered at the laboratory within a few hours of milking, being conveyed in ice-chests in which the temperature does not rise above 45° F. On arriving at the laboratory the milk is divided by the separator into cream, separated milk, and any dirt or foreign matter which may have found entrance. The cream has a fixed percentage of fat, namely 16 per cent. In making up the milk for an infant in accordance with the physician's prescription, the clerks have the following materials ready in glass vessels; (1) The 16 per cent cream obtained from the separator, (2) the separated milk to be used for securing the proper percentage of proteins, (3) a 20 per cent solution of milk-sugar in distilled water, and (4) lime-water. With these materials the modifying clerk combines each infant's food according to the prescription before him, and then pours it into the glass tubes from which the infant is to be fed. These tubes, each of which contains the milk for one meal, are closed with a plug of non-absorbent wool, and placed in baskets with compartments equal in number to the meals which the infant is to receive daily. The baskets and their contents are placed in the sterilizer, and after having been subjected to the required temperature, are taken to the cooling tank where the temperature of the food is reduced to 28° F. They are then ready to be sent to the customer's house.

As an example of how laboratory milk is ordered by the physician, Dr. Rotch gives the following prescription for a healthy infant of four months.

	Per cent.	
Fat	4	Reaction slightly alkaline.
Milk Sugar	7	Number of feedings, 7.
Proteins	1·50	Amount at each feeding, 4½ oz.
		Heated for, 20 minutes.
		Heated at, 167° F.

More recently by the use of whey, the protein constituents can be split up and ordered as casein and lactalbumin in the percentage desired.

The advantages claimed for this method are that the composition of the milk is exactly determined so that it may be made the same as healthy breast milk, or may be altered by the physician to suit the infant's requirements. The milk is sterile, free from dirt, and has not lost its quality of freshness, unless sterilized at too high a temperature or for too long a time. It is said to be suitable for healthy infants and to prevent digestive disturbances, as well as cure them, in those who have not had a similiar diet.

It is possible that in America the infantile stomach does require some such milk, for one cannot but be struck by the amount of writing and the diversity of opinion in that country on the subject of infant feeding. In this country there are but few milk laboratories, and the need for them does not appear to be very urgent. When pure fresh milk is obtainable the needs of the infant can be met by simple home modifications, and when it is not obtainable no laboratory treatment will render stale milk wholesome. The retail price of laboratory milk, about 8*d.* per quart, will tend to put it beyond the reach of most. Opinions still differ as to the effects of this mechanical treatment of milk, the splitting it up and the recombination. Some hold that both the proteins and the fats are rendered less digestible. It is admitted by all that a considerable amount of practice is required before the exact percentage amounts necessary for different infants can be learned. Many clinicians find themselves unable to determine those minute percentage differences in the proteins, fats, etc., which are placed at their disposal by this method. Many hold that such minute differences are not called for in infant feeding. In the pre-laboratory days, the differences of opinion as to milk feeding were ascribed to the want of any definite composition in the milk, now the differences of opinion seem to take place over which standard to select, when the various solids of milk can be differentiated to two decimal points. The tendency in this country, and we think it is a wise one, is to have as little tampering with the milk as possible, and this system of separating, recombining and sterilizing milk opens the door to many possibilities of error in the preparation. No one can tell that the milk supplied is the same as the milk ordered. One ignorant or careless dispenser may be productive of much mischief.

Before recommending the use of laboratory milk we should like to see some more evidence of the necessity for it in this country, and some more unanimity of opinion as to its advantages in America.

Many dairies in this country subject the milk to a process of separation and combination with cream and sugar in order to form a mixture which is known as "**humanized milk.**" It is supposed to resemble breast milk in chemical composition. This preparation has no advantages over milk which has been modified at home, and the composition of the mixture cannot be regarded as uniformly the same.

4. Municipal milk.—Within recent years the feeding of infants has been taken up by some municipal authorities as a means of preventing the great mortality during the first year of life. The French, led by the late Professor Budin of Paris, have been the pioneers of this work, and in France each milk distributing centre, known as a "Consultation de Nourissons" or "Goutte de Lait," is either self-supporting or is aided by the funds of the charitable. At first these centres were started by the energy and enthusiasm of some medical man who was familiar with the problems of infant feeding, but more recently some of the municipalities have taken up the work. In England the municipal milk depôts have been modelled on the French system and are under the supervision of the district medical officer of health. Special measures are taken to ensure that the milk supplied shall be from a well kept farm and of good quality. After being cooled at the farm it is sent to the depôt in sealed churns and is there strained, modified according to the age of the infant, bottled and sterilized. Each bottle holds enough for one meal, and the mother receives a sufficient supply of these bottles for one day.

With the excellent intentions of those who have introduced these municipal depôts, and with the undoubted benefits conferred on the mothers by the advice they receive, we have not here to deal. If this system is to spread medical men will wish to know whether the infants are fed in a proper manner. The chief aim of the supporters of the system is to prevent the great mortality in infants under twelve months of age caused by infantile diarrhœa, as is known, and by tuberculosis, as is believed by many. This is secured by supplying sterilized milk direct to the infant. Tables have been put forward which profess to demonstrate a great reduction in the infantile death rate throughout the areas supplied by municipal milk. In these reports diseases which are not fatal, but which may be traceable to the method of feeding, are not considered, nor will fatal results after the age of twelve months, although traceable to dietetic faults in the earlier months, be tabulated.

Cases of scurvy from the use of municipal milk have been reported. The advantages and disadvantages of sterilization have been already discussed, and we have pointed out that sterilized milk does not appear to be a safe diet for infants. Nor does it appear advisable to modify the milk for infants according to an age standard only, to give one and all the same food in the same amount with the same regularity. Their minds later on will be fed on this system at the board schools, but it is not asking too much to request a little more attention to the individual requirements of their bodies during the earliest months of life. If municipal authorities could only ensure a supply of fresh, pure, unadulterated milk through the districts which they control, by the direct supervision of farms and dairies, they would undoubtedly lower the death rate and raise the standard of health amongst infants to a far greater extent than the milk depôts can ever do.

5. Budin's method.—Professor Budin introduced the method of feeding infants on sterilized milk, without dilution or addition. He was led to adopt this plan because in his experience infants fed on diluted milk were obliged to absorb great quantities of fluid which caused them to pass a large amount of urine, and because they were almost always crying from hunger. On the other hand he found the feeding was greatly simplified by using undiluted sterilized milk. During the first month of life it may be necessary to use a slight amount of dilution owing to the larger amount of casein or fat that may be present in cows' milk, but his custom has been to avoid dilution unless under special circumstances. If the food did not agree he considered that the ill effects were due to too much food having been given. The amount of whole milk to be ordered for an infant varies from 400 to 600 grammes (14 to 21 oz.). He claimed to get most satisfactory results; amongst others "no tumid abdomens, no undiluted milk dyspepsia, no rickets, no eczema, no tuberculosis, no scurvy, and no weakness or flabbiness." His method has received the support of some distinguished accoucheurs in this country.

The first thing that strikes one about this method is the fact that infants should thrive on it at all, as cows' milk differs so markedly in chemical composition from breast milk. Apparently it has been possible in Paris to rear infants on undiluted cows' milk. The sterilization employed is probably an important factor, as the curd formed in milk after exposure to a high temperature is soft and may more easily slip through the pylorus. Dr. Cautley suggests that in such cases the digestion must be mainly intestinal. It is generally recognized that whole cows' milk is not suited to an infant's digestive powers owing to the large protein content. If these proteins are chemically altered by heating so as to be tolerated in large amount the stomach has probably got to deal with some unnatural food. The effects of sterilized milk on an infant's nutrition have been already considered, and the experience of most has condemned it. It will therefore require a good deal more proof of the advantage of Budin's method than has been forthcoming so far before physicians will adopt this system. In weakly infants and in diseased conditions the dilution of the proteins has been found an important part of successful feeding with cows' milk. Universal experience of this kind cannot be upset by dogmatic statements. Professor Budin seems to have been particularly unfortunate in his experiences with simple modification of the milk, a method which has firmly established itself as suitable for the majority of infants.

6. Top milk.—The importance of securing a full amount of fat in the dietary, and especially in the natural form of gravity cream, has led to the adoption of top milk mixtures by many. The upper portion of the milk after standing is separated from the lower and used for the infant. This is done by using a glass vessel with a large opening and syphoning off the lower portion of the milk, which is to be used for puddings, etc., or the upper half or third of the milk, as may be considered best for the infant, may be ladled off. Chapin's dipper may be used for this purpose.

Dr. Ashby's plan is as follows: Thirty ounces of fresh milk are placed in a glass bottle and allowed to stand for four or five hours in a cool place, the opening of the bottle being closed with cotton wool. At the end of this time the upper 10 oz. will contain an average of 10 per cent. fat while the upper 15 oz. will contain 7½ per cent fat. The lower two-thirds (20 oz.), or the lower half (15 oz.) should then be syphoned off, according to the strength required, and replaced by water with 1 oz. of sugar-of-milk dissolved in it.

The mixture is pasteurized and then cooled rapidly in running water or ice. The weaker mixture will contain protein 1–1·3 per cent, fat 3–3·5 per cent, and milk sugar 6 per cent, while the stronger will contain protein 1·75 per cent, fat 3·35 per cent and sugar 6 per cent, i.e. a slightly larger amount of protein. Infants at the age of three weeks should be able to take top milk containing 10 per cent fat diluted with two parts of sugar-water, and at the age of three or four months, top milk with 7 per cent cream, diluted with an equal quantity of sugar-water. The strength of the cream mixture can be diminished for weakly infants, or those suffering from digestive disturbances.

Dr. Cautley gives the following details. Fresh cows' milk is allowed to stand for three hours, and the top half is separated. This contains about 8 per cent of fat and the usual percentages of protein and sugar. For an infant under three months he takes 5 oz. of this top milk, and adds 1 oz. of lime-water, 6½ drachms of sugar and 14 oz. of water. The mixture will then have the following composition: protein 1 per cent, fat 2 per cent and sugar 5 per cent. If the mixture is well digested, the strength can be gradually increased by adding 1 oz. of top milk and subtracting 1 oz. of water, once or twice a week, until the mixture consists of top milk 10 oz., lime-water 1 oz. and water 9 oz. (or a percentage of the solids given above, 2-4-6). If more fat is required in the food, all that is necessary is to use the top third or the top fourth, in making the mixture. He finds that by this method with very little trouble and with sufficient accuracy the diet can be altered in details in any particular case, provided that a milk of fairly steady average composition is used and that the details are carefully carried out.

More elaborate variations in the use of top milk have been described, but the above methods are simple and efficient. The advantage in maintaining a full amount of fat in the dietary in the form of natural cream is evident. In families where time and brain power are available for carrying out the details this method will be found most useful. The quality of the milk is not interfered with in any way and it may be boiled or not according to the conditions previously discussed. There are no drawbacks associated with this method which might prove prejudicial to the infant's health at a later period. At the same time the strength of the milk in cream must be regulated by the physician. Experience has shown that the natural instinct of the mother is to make the mixture as strong as possible and that fat indigestion is apt to follow. A mixture containing from 6 to 8 per cent of fat is not readily tolerated for long, and such mixtures will often be made by the use of top milk unless the precise directions of the physician are correctly carried out. Owing to the varying strength of cows' milk in cream, it is advisable to take rather less top milk than the above mathematical calculations would suggest, so as to avoid indigestion from excess of fat.

7. Whey.—This is sometimes employed as a modification of milk by which the insoluble proteins are removed. Whey is prepared by adding a drachm of liquid rennet to half a pint of warm milk (104° F.). After the mixture has been stirred it is allowed to stand until coagulation has taken place. The curd is then broken up thoroughly and the whey is strained off through muslin or a strainer. Half a pint of milk yields 7 oz. of whey. The approximate composition of whey is as follows: proteins ·8 per cent, fat 1 per cent, and sugar 4·75 per cent.

The chief protein is lactalbumin, the casein having been separated in the curd. Sometimes whole milk and sometimes separated milk is used, the difference in the result consisting of the larger amount of fat from the former. When whey is kept any time or is to be mixed with other food it is necessary to heat it to a temperature of 160° F. or boil it in order to check further changes from the rennet ferment. When used as a food for infants the deficiency in fat must be made up by the addition of cream.

The advantages claimed for whey are that the proteins are very digestible, and although in small quantity they are sufficient, with the addition of those in cream. For ordinary cases it is doubtful whether the trouble of preparation is justified by the result, and whether the normal stomach should not be employed more actively in doing its proper work. As a temporary measure in cases of difficult digestion or disease whey is most useful, and its application in such cases will be considered later on.

Dr. Still considers that whey may be used with great benefit as a diluent of cows' milk in infant feeding. The proportion of curd-forming caseinogen is reduced without reducing the proportion of lactalbumin, and the mixture approximates more nearly to human milk in respect of its lactalbumin than is possible with any other diluent. He shows this in the following table.

	Mixture.	Resulting Percentages.
Milk	6 drachms.	Casein, 0·81 per cent.
Whey	18 ,,	Lactalbumin, 0·75 ,,
Cream (48 per cent fat)	1 drachm.	Fat . . . 3·87 ,,
Milk sugar . . .	½ level teaspoonful.	Sugar . . 6·50 ,,

This is a very close imitation of breast milk as regards the chemical composition, but it requires very careful supervision of the ingredients and their preparation to ensure correct results.

8. Citrated milk.—Attempts have been made to overcome the casein difficulty in cows' milk by the addition of citrate of soda. In 1893 Wright drew attention to the importance of the calcium of cows' milk in producing the dense curd. Human milk contains ·03 per cent of lime, while cows' milk contains ·17 per cent.

The chief base in human milk is potash, while in most other milks it is lime. This excess of lime in cows' milk can be dispensed with without injury to the nutrition of the infant, as the lime is presumably there with a view to the calf's walking powers being called into play almost immediately after birth, and an infant does not walk for a year. Rennet coagulation is delayed and curdling becomes less and less firm as an increasing proportion of the lime salts of the milk becomes precipitated as insoluble salts. Wright found that the addition of a solution of citrate of soda sufficed to prevent any coagulation by rennet, by precipitating the lime as an insoluble salt, and he suggested the use of citrate of soda as a means of "humanizing" cows' milk for infants. The chemical changes involved are not exactly known, but are thus explained by Poynton. The caseinogen of milk is acid, and in the process of clotting combines with the calcium salts in the milk to produce the thick casein clot (calcium casein). Sodium citrate, when added to the milk, combines with the caseinogen, and a sodium compound is formed (sodium casein). The latter is of lower molecular weight than the calcium compound and hence of less density. The calcium salts of the milk combine with the citric acid to produce calcium citrate, which is absorbed into the system and so the lime is not lost to the economy. The density and toughness of the clot varies inversely with the amount of citrate of soda used, so that by increasing the amount a very fine coagulum is produced. For ordinary cases Poynton uses a solution of the strength of one grain of citrate of soda in a drachm of water. Of this 1 drachm is added for each ounce of milk in the food as prepared for use. Thus if an infant is taking 20 oz. of whole milk in the day, it will receive 20 grains of citrate of soda. In cases in which a finer curd seems to be required he uses two or even three grains of citrate of soda to the ounce of milk. The amount of citrate of soda required by the infant can be determined after trial with a small dose by the moaunt of curd passed in the motions. When the solution is prepared in bulk, say 12 oz., a few drops of chloroform should be added to prevent a mould forming. The citrate of soda may also be obtained in the form of tabloids of one, two, or three grain strength, for convenience in travelling. Poynton has recommended his method chiefly in connexion with the weaning of infants, and for the correction of milk dyspepsia, but it has also enabled him to increase the amount of milk which can be taken in the twenty-four hours. He finds that the milk thus treated is palatable, is somewhat constipating, is well tolerated by most infants, and is followed by no bad effects, so far as he has seen. The method is a cheap one, citrate of soda costing about 2*d*. an ounce, and it can be carried out in every domestic circle. Citrated milk has also been used as a method of feeding healthy infants by other physicians, who report favourably on its use.

The advantage claimed here is the diminished denseness of the casein and the increased digestibility of the milk. A sufficient time has not elapsed to test thoroughly the results of this method. The addition to the diet of citrate of soda in the doses prescribed is not probably injurious in itself, although such chemical treatment of milk should preferably be avoided. As Poynton states, citrates are a normal constituent of cows' milk and are not known to act injuriously on the body. There is no evidence that the stomach is not called on to do a proper amount of work in digesting the milk, and the excessive dilution which is called for by some forms of modification is here unnecessary. We think that this method is worthy of a full trial at the hands of the profession, both as regards healthy infants and those who do not take kindly to diluted cows' milk.

9. Predigested milk.—Another method of overcoming the difficulty in digesting the casein of cows' milk is to employ some digestive ferment to peptonize the milk before use. The stomach is then not called on to perform the whole process of digestion, and gastric disturbances may be avoided. Various powders and fluids are employed as peptonizing agents, but for infants' use Fairchild's peptogenic milk-powder will be found most suitable. Each powder contains the ferment necessary for a certain amount of milk, cream and water, along with bicarbonate of soda, to render the mixture alkaline, and milk-sugar to bring the carbohydrate material up to the normal standard. The milk, cream, water and powder are mixed according to the directions supplied, and the mixture is kept at a temperature of 104°F. for ten, twenty, or thirty minutes, according to the degree of peptonization required. It is then quickly brought to the boil in order to check the further action of the ferment. Chemical analysis shows that milk thus prepared resembles breast milk very closely, and the similarity is seen also in connexion with the stomach, where peptonized milk forms a soft flocculent mass like the curd of breast milk.

The value of this method of treating milk does not lie in the feeding of healthy infants. The plan is not physiological, for the stomach is meant to do its own work of digestion and not to have predigested food supplied. One cannot expect the stomach to develop normally unless it performs its own proper functions. Further, we are dealing here with foods which form a safe diet for infants, and predigested milk does not come into this category. Many cases of anæmia and scurvy and failure of nutrition have been traced to the prolonged use of predigested milk It is probably the case that these occurred when prolonged peptonization had been carried out, say for an hour or longer, but the fact remains that perfect nutrition cannot be expected when the food is artificially predigested. The value of peptonized milk is seen in connexion with the special feeding required by premature or weakly infants and in cases of disease. This subject will be referred to later

10. Addition of decoctions of cereals.—We have already referred to the use of barley-water as a diluent. This, if made as directed for infants, is not of any nutritive value, but is a bland fluid which diminishes, to a slight extent, the denseness of the curd in the stomach. Some able writers (Jacoby, Chapin, etc.) have recommended that stronger decoctions of cereals, barley, wheat, or oats, should be added to the milk not only as an aid to digestion but also for their nutritive properties. As with many other substances, it may be possible to rear infants on these decoctions, but the method is not in accordance with nature's teaching. The only carbo-hydrate in breast milk is milk-sugar, and starches do not occur in any form. Another practical difficulty in connexion with the use of these decoctions is that, although they may be prescribed in a dilute form, the tendency of the nurse will be to make them stronger and stronger, in the belief that they are so much more nourishing than milk. In the case of healthy children they are not required, and in the case of infants with weak digestion they are probably injurious.

We have now considered the various forms of modifying cows' milk which are employed in the feeding of infants. There are other food preparations on the market, each of which is recommended by the makers as a complete food for infants. There are dried milk preparations, condensed milk, and the so-called "infants' foods," usually containing more or less starch. They have been fully described in another section of this volume. Every opportunity has been seized by the public to try these food substitutes, and consequently the medical profession has also been able to test their value. All have been proved and have been found wanting. Many forms of disease are directly traceable to their prolonged and exclusive use. As regards healthy infants, therefore, these foods should not form part of the diet up to the age of nine months. After that age they may be employed in moderation as a part of the diet. The question of their employment in certain cases of disease and debility will be considered later.

In connexion with the subject of these proprietary preparations we may consider the meaning of the term "a complete food for infants." From the medical standpoint a complete food for infants, during the first nine months, must fulfil the following requirements. It must contain the various elements, proteins, fats, and carbo-hydrates, which are found in breast milk, in a proportion suited to an infant's digestive powers, and in amount sufficient for the requirements of all the growing tissues. Per contra, it must not contain elements which are not found in breast milk, and which are not suitable to an infant's digestive powers. It must consist of fresh or living food, which means that it must not have lost its freshness through keeping, or prolonged heating, or drying, or predigestion. It must be free from extraneous organisms, or contain them only in such numbers as not to affect injuriously the food or the gastro-intestinal mucous membrane. It must not, in the process of preparation, be treated by mechanical or other means, as to alter the component elements and render them unsuitable for digestion.

Were some such standard adopted in connexion with the feeding of healthy infants, a number of foods which are now largely used would be entirely abolished, with great benefit to the rising generation.

THE DIET AFTER WEANING

Diet from nine to twelve months.—We have been considering hitherto the food materials suited to an infant during the first stage of life which terminates at nine months. This epoch is marked by the eruption of the first tooth, which is supposed to indicate the time for weaning.

In the case of breast-fed children the ordinary time to commence weaning is at the age of eight or nine months. At the same time if the mother has plenty of milk and is healthy, and if the infant is thriving and satisfied, there is no harm in continuing the process until the child is twelve months old. Under certain conditions it may be advisable to do so, for example in the middle of the hot season, when it is so difficult to obtain fresh pure cows' milk. Also if there have been serious feeding difficulties in the earlier stages of the nursing, the weaning may be deferred as it will probably be a time of further difficulties which the infant will be better able to meet later on.

If it has been decided on medical grounds that weaning is advisable it should not be deferred because "the baby won't take anything but the breast." This is purely a figment of the maternal imagination, and history does not relate any example of a healthy infant committing suicide by refusing bottle food. The weaning process should be carried out gradually and may be spread over three weeks or a month, so as to accustom the infant and its digestive organs to the change of food. Cows' milk, in one of the modifications described, should be given. A mixture of milk, cream, and malt extract will be found suitable, diluted with an equal amount of plain water or barley-water to begin with. The time selected for the first bottle should be one when a healthy appetite is present, increased perhaps by an added feeling of hunger from a longer fast than usual. The infant will then be less critical about the change of nourishment and feeding apparatus. In some cases a considerable amount of patience and perseverance will be called for. After weaning other foods may be added as in the case of bottle-fed babies.

The bottle-fed baby has no weaning process to pass through at this age. By some it is held that before the age of nine months an infant should have some farinaceous food in addition to cows' milk, but as a rule this is neither necessary nor desirable in the case of healthy infants. In some cases such food may be ordered medically, as for example in the presence of indigestion or constipation. Cows' milk supplies all the physiological requirements of an infant up to the age of nine months. For the following three months no other food is absolutely necessary, but the digestive organs are now capable of dealing with carbo-hydrate material in some other form than sugar alone. The great change at this age is the addition of other carbo-hydrate material to the diet, but this is to supplement and not to replace cows' milk. While both the quality and the quantity of the added carbo-hydrate are important, the chief danger lies in the latter. The tendency of mothers and nurses is to increase the amount of carbo-hydrate too rapidly, in the belief that the more it takes the stronger will the child be. Thus the digestive organs may be overtaxed and the tissues may be loaded with an excessive amount of carbo-hydrate material.

The cereals in common use at this stage are wheat, barley, and oats. Oatmeal porridge, although largely used in Scotland, seems to be regarded with distrust in England. It is considered to be "heating"—a somewhat vague term—and to be responsible for the production of spots on the skin. The real drawback to its use is that it requires prolonged boiling to be thoroughly digestible and this may explain its unpopularity in certain quarters. The question of easy and rapid preparation is an important one in many households and largely determines the nature of the food to be used. As a first addition to the diet, we may begin with one of the good proprietary foods for infants, in which the starch has been converted, e.g. Mellin's, or Savory and Moore's, or Benger's. When this is tolerated, we may change to wheat flour or prepared barley, or bread, or bread jelly prepared according to Dr. Cheadle's formula, or milk pudding.

The preparation of wheat flour, according to Dr. Eustace Smith, is as follows: A covered earthenware jar filled with the flour is put in a slow oven. From time to time it is removed, and the contents stirred up from the bottom and sides so as to prevent the formation of hard lumps. When thoroughly baked the flour forms a soft greyish-coloured powder. For each meal one teaspoonful of the prepared flour is rubbed up with a tablespoonful of cold milk into a smooth paste. A second spoonful of cold milk is then added, and the rubbing is repeated until the mixture has the appearance of a perfectly smooth cream. A quarter of a pint of hot milk or milk and water is then poured upon the mixture, to the accompaniment of brisk stirring, and the food is ready for use. It may be sweetened with extract of malt instead of sugar.

Prepared barley is cooked as follows: A tablespoonful of the ground barley is added to a pint of cold water and the mixture slowly boiled down to half a pint. Of this a dessertspoonful may be added to 6 oz. of milk for a meal. It is preferably sweetened with malt extract. It will be noted that barley-water as a diluent of milk for infants is different from the above and is not used for its nutritive properties.

Bread and milk is prepared as follows: A slice of stale bread without crust is soaked in a basin of cold water for two hours; the water is then poured off, the bread is beaten up, and over it is poured a quarter of a pint of boiling milk. This may be sweetened with sugar or malt extract.

Dr. Cheadle's formula for bread jelly is more elaborate but produces a very digestible food. A thick slice of stale bread (4 oz.) is soaked in a basin of cold water for six or eight hours and then squeezed out. The pulp is gently boiled in a pint of fresh water for an hour and a half. The thick gruel thus made is strained, rubbed through a fine hair sieve, and allowed to cool, when it forms a smooth jelly. Enough of this is mixed with warm water to make a food of the consistence of thick cream (about one tablespoonful to eight oz. of water); a little white sugar may be added.

The full dietary at this age may be said to be reached when the infant is taking from one and a half to two pints a day of undiluted cows' milk, and two meals a day of thin oatmeal porridge and milk, or boiled bread and milk, or milk pudding. Dilution of the milk is not necessary, but one or two oz. of gravity cream may be given in the case of healthy and strong infants. The farinaceous material should be given at first in small quantity and later on in increasing amount, but never more than twice daily. The total number of meals in the day should not exceed five. Spoon-feeding should be begun as soon as possible, but as regards that matter, and also the addition of solids, due deference must be paid to the infant's own ideas, which are sometimes very decided. In some cases it will be found that solids are persistently refused, and that anything of a greater consistency than milk will not be swallowed. This peculiarity passes off in time. A few teaspoonfuls of orange-juice or grape-juice daily in water will be found serviceable all through infancy in supplying the antiscorbutic element in food which modern methods of treatment rather tend to destroy. Dr. Sim Wallace recommends that when the incisor teeth have been cut, the infant should be given some fresh sugar-cane, or fruit, or a stale crust to bite and gnaw at. He is firmly convinced of the faulty nature of a prolonged "pappy diet" and of the bad results in the shape of dental caries. Although many infants do not take early to biting we believe that some such biting process is an excellent training for that thorough chewing which is so essential later on.

DIET DURING THE SECOND YEAR OF LIFE

The same guiding principle is to be observed here, namely, that the child should have an amount of the three chief elements, proteins, fats, and carbo-hydrates, sufficient for the nutrition of the body, the repair of tissues, and the more active movements which are now developing. The digestive organs are now capable of dealing with more concentrated material so that more solid food can be given. The food must be of a nature suited to the young child and must be selected according to the guidance of experience. It is not to be inferred that the strengthening food of a healthy adult is equally strengthening to the young and developing digestive organs of the infant. The teeth are present for a definite purpose, so that a certain amount of the food should be hard, and biting and chewing be rendered necessary. There should be no bottle-feeding after the first year as the infant can now take solids out of a spoon and fluids out of a cup. The meals should not exceed four in number and there should be no night feeding. The foods to be advised are those which are plain, wholesome and nourishing, and which at the same time call for the exercise of all the digestive powers. The foods to be avoided are the patent preparations of predigested or partially digested materials, the tinned and preserved foods of all kinds, whose only recommendation is that they are rapidly prepared, and the meat juices and beef soups which are popularly regarded as very nourishing. All these foods, which may serve a purpose in restoring a temporarily disabled digestion, are only a means of reducing the efficiency of a healthy stomach and preventing its development on normal lines. A considerable amount of variety in the meals is desirable, and is easily obtained within the limits of suitable food.

Breakfast (to be selected from the following).—Milk, porridge, boiled bread and milk, an egg, bread and butter, fat bacon.

Half a pint of milk should be taken at breakfast. It may be given plain (hot or cold) or flavoured with cocoa, or along with porridge or bread. The porridge should at first be made of fine oatmeal or groats, or rolled oats, and should be of semi-fluid consistency. Later it should be thicker and made of coarser oatmeal. The refined preparations of oatmeal are more rapidly cooked and more easily digested, but they do not possess the same amount of nitrogenous and mineral matters as the coarse. Boiled bread and milk is palatable and nutritious, and can be made thicker, as the child grows. An egg contains a large amount of nutriment, which as a rule is suited to most infants, but in a certain number produces disagreeable results. This can only be determined by experience, but if really fresh eggs could always be obtained, the results would probably be more generally favourable. The yolk of an egg can be given, beaten up in milk. After fifteen months of age the whole egg can be given, lightly boiled, or poached, or scrambled, with bread and butter. At this age also a piece of fat bacon supplies the fatty element in a digestible and palatable form.

Dinner (to be selected from the following).—Milk, potato, gravy, milk pudding, suet pudding, stewed fruit, biscuit, rusks, bread, raw fruit, pounded chicken or fish.

From 5 to 10 oz. of milk should be taken at dinner. Potatoes are much relished by children, and mixed with milk or gravy or butter they form a useful part of the diet. Potatoes should be boiled until of a floury consistency and then put through a sieve. Beginning with a teaspoonful of this the amount may be gradually increased until two tablespoonfuls are taken. All the milk puddings are useful. At first they should be of a creamy consistency and watery but gradually they are to be made thicker. A milk pudding may be made as follows. One tablespoonful of rice or tapioca, after being thoroughly washed, is put into a pie dish with a pint of milk and allowed to stand for an hour. It is then sweetened, and baked in a slow oven for an hour. Suet puddings supply a large amount of fatty material, and some jam or golden syrup or stewed fruit may be combined with them. An orange or a banana or some grapes form a pleasant finish to the meal. During the latter half of the second year some pounded fish or chicken may be given occasionally at this meal. Plain biscuits or rusks should be eaten as they call into play the masticatory apparatus more than soft bread does. There should not be more than two courses at dinner time.

Tea.—Milk (half a pint), cocoa and milk, bread and butter, biscuits, rusks, honey, jam, an egg occasionally.

As regards intermediate meals at this age, one will allow at first some milk or boiled biscuit and milk between breakfast and dinner, and some hot milk before going to bed if desired. Dr. Sim Wallace points out that a drink of milk is not the best thing before going to bed as it leaves a suitable nidus about the teeth for micro-organisms to develop in. This may prove a factor in dental caries. He recommends instead some tooth-cleaning food such as a piece of stale bread or dry biscuit, and this should preferably be given as soon as the child has reached the chewing age. This age is reached much sooner if the child is accustomed early to hard foods, which call into play the masticatory powers.

Dr. Eustace Smith recommends the following dietaries—

From twelve to eighteen months of age.

First meal, 7.30 a.m. A rusk, or a slice of stale bread, well soaked in a breakfast cupful of new milk.

Or the yolk of a lightly boiled egg, a slice of thin bread and butter, and a cupful of new milk.

Second meal, 11 a.m. A drink of milk, with a slice of thin bread and butter or a biscuit.

Third meal, 1.30 p.m. A teacupful of good beef-tea (1 lb. of meat to the pint) or of beef gravy, with rusk. A good tablespoonful of light farinaceous pudding.

Or a mealy potato, well mashed with a spoon, moistened with two tablespoonfuls of good beef gravy. A cupful of new milk.

Fourth meal, 5.30 p.m. Same as the first.

Or a rusk or slice of stale bread, well soaked in a breakfast cupful of milk.

Fifth meal, 11 p.m. (if required). A drink of milk.

From eighteen months to two years old.

First meal, 7.30 a.m. A breakfast cupful of new milk, with a rusk, or half a slice of bread soaked in the liquid fat of hot fried bacon.

Or a breakfast cupful of new milk, with the lightly boiled yolk of one egg, and thin bread and butter.

Second meal, 11 a.m. A cup of milk and a biscuit.

Third meal, 1.30 p.m. Underdone roast mutton (pounded in a warm mortar), a good tablespoonful, with one well mashed potato, moistened with two or three tablespoonfuls of gravy. For drink, filtered water or toast water.

Or a breakfast cupful of beef-tea, containing a few well boiled asparagus heads when in season, or a little thoroughly stewed flower of broccoli. A good tablespoonful of plain custard pudding.

Fourth meal, 5.30 p.m. A breakfast cupful of milk, with thin bread and butter.

Dr. Edmund Cautley recommends the following diet **from twelve to eighteen months of age—**

First meal, at 6 to 7 a.m. 6 oz. of boiled milk, hot or cold; a slice of stale bread, or a rusk broken up and soaked in the milk, or a slice of thin bread with dripping or butter.

Second meal, at 8 to 9 a.m. One of these daily: A small basin of bread and milk. A little fine oatmeal porridge, with cream or milk. A basin of thick milk gruel. A cup of thin cocoa made with milk, and a little thin bread and butter.

Third meal, at 1 p.m. First course: One of the following:—Mashed baked old potato moistened with milk, chicken or mutton broth, the red gravy of undercooked meat, or meat juice (1–3 oz.). Lightly boiled or poached yolk of egg mixed up with stale bread crumbs, or mashed potato and gravy. Stale bread crumbs soaked in gravy or meat juice.

Second course: One of the following:—A large tablespoonful of custard, tapioca, cornflour, ground rice, or semolina pudding, blancmange, or junket.

Cold boiled water or milk and water to drink.

Fourth meal, at 5 p.m. The same as the first, or thin cocoa with bread and butter.

Fifth meal, at 9 p.m. A large cupful of milk gruel, made with rice, sago, tapioca, or hominy. Or, a rusk or sponge finger soaked in milk.

Experience has shown that certain dangers are present in connexion with the feeding at this age. It is very common to find that the young child is supplied with too much carbo-hydrate and too little fatty food. The excess of carbo-hydrate is often supplied in the form of bread and butter or sweet pudding. It may be from pressing on the part of the parent or from the palatability of the food that too much is taken, but a limit must be placed on the consumption of these popular articles. A child with a healthy appetite will not as a rule eat too much plain food, but sweetened up articles of diet may prove too attractive from their sweetness. When a sufficient amount has been taken it is better to offer a dry biscuit or a piece of dry bread, which will satisfy any remaining appetite without disturbing the digestion. Many children do not get a sufficient amount of fat. By some young people fat is avoided in certain forms from a natural distaste which, however, passes off as a rule in the course of time. Children should not be compelled to eat the forms of fat they dislike, for a positive repugnance may thus be established. As a rule, amongst the various forms of food in which fat is present, such as cream, butter, bacon, oil (cod-liver or salad), dripping, suet, and yolk of egg, it is possible to find some palatable variety. The most marked dislike is to beef and mutton fat. As fat is most important for the growth of the body, and carbo-hydrates fail to meet this demand, a sufficiency of animal fat must be administered. The tendency to like certain articles of food and to dislike others must be checked, as it simply means that the more palatable are preferred. This evil is often started by giving infants milk which has been too much sweetened and a distaste follows for less highly flavoured foods. Some young children will take very readily to beef and mutton, but these must be given in strictly limited amounts. Coaxing to take more food at meals should never be indulged in. Healthy children do not require coaxing, and loss of appetite is often nature's method of securing a curative fast for some temporary disturbance. If coaxing to eat is employed when the stomach and liver are upset by too much food the result will simply be an aggravation of the disturbance. It is a bad plan to bring young children to the family table. They are much better placed in the nursery where they can eat without distraction. At the family table there are many things which they should not eat, which they promptly demand, and which they too often get. As the meals become more solid, young children should be encouraged to drink water freely between meals. Effervescing waters are not palatable at this age, but fresh water should always be at hand. Tea, coffee, and all forms of alcoholic fluids are to be strictly forbidden.

DIET IN CHILDHOOD

Diet from the second to the seventh year.—The alterations in the diet at this period are as regards the quantity rather than the quality of the food materials. The active exercises which characterize a child at this age call for an increased amount of carbo-hydrates and of proteins, in other words of energy-producing and muscle-forming material. The meals should be three in number and no feeding between meals should be encouraged. At the same time if the child is really hungry, a piece of dry bread or biscuit with an apple may be given occasionally. It is a parent's duty to satisfy the appetite of the child, not to try and coax it with sweets and strongly flavoured delicacies.

Milk should still be an important part of the diet, either plain or in puddings or with cocoa. Tea and coffee should be deferred until the latter part of this period, and then should only be used as a flavouring to the milk. Eggs and butter and cream should also form a regular part of the diet.

The proteins of meat are very digestible and very appetizing but must not be given in excess owing to their stimulating properties. A little minced or finely cut beef or mutton may be given every second or third day. Fish in the form of boiled or steamed sole, whiting, haddock, herring, or cod is more suitable. Chicken, rabbit, calf's head, and game which is tender but not high, will be found to be palatable and to lend a sufficient amount of variety in the diet. Meat soups should not be made strong. A small amount of meat stock may be used as flavouring to make vegetable soups with carrots, turnips, rice, cabbage, potatoes, etc. For a few years these may be given after straining, but later all the vegetables present in the soup may be taken. Beef essences, meat juices, and prepared concentrated foods are not required by children in health. The training in mastication should be perseveringly continued by the use of some hard articles of food. Until this is learned it may be necessary to give meat in a pounded, minced, or shredded form. The habit of bolting the food, acquired from the fluid diet of infancy, must be checked, and a slow methodical habit of eating should be acquired early in life.

Bread forms a most important element in the diet. The amount of bread and butter or jam that an active four year old child will consume at a meal is astonishing. Care must be taken, however, that the butter or jam is not the element which makes the bread go down. White or brown bread may be used and it should be at least twenty-four hours old. It may be plain, or toasted. All plain biscuits are also to be allowed, sweetened ones being regarded as an occasional luxury.

All the cereals are useful. Porridge, oatmeal or hominy, with milk, syrup, or sugar. Farinaceous puddings of all kinds. If well cooked, puddings are readily taken by children.

Of fresh vegetables the potato is the most popular, and in fact it is the only one which young children do not tire of. Potatoes may be given plain boiled, or mashed, or fried. Cauliflower, cabbage, spinach, asparagus, tomatoes, and peas may be given. All tinned vegetables are to be avoided.

The natural demand of the organism for sugar must be fully satisfied, and it is better to do so by the use of sugar in the food than by the artificial products of the manufacturer, which are often taken in excess apart from meals. Puddings and stewed fruit can be suitably sweetened. Honey, syrup, and jam can be taken with bread, biscuits, and puddings. At the same time it is not advisable to ruin the taste for plain foods by oversweetening a number of the dishes.

Fruits contain a considerable amount of sugar in a very assimilable form. They also contain certain elements which are of especial importance in maintaining a healthy condition of the blood. Grapes, oranges, apples, bananas, pears, cherries and plums are suitable. They should form part of the regular diet of the child, so that some fruit is taken every day. In hot weather it will be found useful to reduce the amount of the more substantial elements of the diet and to increase the amount of the fruit and vegetables. Special care must be taken to ensure that the fruit is in proper condition, i.e. neither unripe nor too ripe, as unwholesome fruit disturbs the alimentary tract most seriously. Tinned fruits should not be used as a sufficiency of fresh fruit is always obtainable.

DIET DURING SCHOOL LIFE

The child has now reached an age when, in addition to the requirements of the body for growth, repair and exercise, we have to consider the work of the brain in connexion with the diet. It is recognized by all that a growing boy or girl requires a large amount of nourishing food, and that at the same time the amount varies very largely with the individual. Consequently it is not advisable to stuff the child who does not appear to come up to an imaginary standard, nor to starve the child who seems to go beyond it. If the child is having a duly apportioned amount of work and play, of sleep and out of door exercise, his appetite will be the best guide as to the amount of food required. The appetite must be a healthy one, i.e. trained on a diet of wholesome plain foods, for a pampered appetite, previously developed on dainty highly seasoned dishes, cannot be regarded as of any value whatever as a test. Children with a debased appetite of this sort, which is of course due to faulty feeding at home, had better be sent to a boarding school at once where the social customs will soon effect a perfect, if at first a somewhat painful, cure. At this age one often meets with the child who cannot take this and cannot take that at home, although on physical examination no defects are visible. He or she had better also be sent to board at school. It cannot be too strongly impressed on parents that the inability of healthy children to take ordinary food is imaginary, is produced directly by previous erroneous feeding, and is fostered by parental weakness. The proof of this is shown by the fact that when the child is placed amongst other children who are eating ordinary food, the inability promptly disappears. On the other hand one must remember that there is not infrequently met with the neurotic boy or girl with certain idiosyncrasies as regards diet. These require special study and special treatment. The amount of exercise which a child takes in the open air will have a direct influence on the appetite, and also on the quantity of food he should take. Exercise before food should not be pushed to the extent of producing exhaustion, or both the appetite and the digestion will be impaired. The natural man tends to rest after a meal but the healthy child will be eager for exercise. Consequently it is not necessary to forbid such exercise, provided that it is of the nature of play, and not of a tiring character. A strenuous game of football immediately after dinner is distinctly injurious.

The quality of the diet should be such that a due proportion of proteins, carbo-hydrates, and fats enter into it. The chief difference from the feeding in the earlier years is that a larger amount of beef and mutton is called for. Although the proteins required can be supplied in other foods, meat has the advantages of being the most concentrated, the most digestible, and the most palatable form in which they can be given. Meat should be given twice a day, once to provide for the wear and tear of the body and a second time to supply the means for growth, as Dr. Clement Dukes rather quaintly expresses it. Additional proteins are to be supplied in the form of milk, eggs, oatmeal, etc.

The freshness of the food is a most important consideration. A preference is to be given to freshly killed English beef and mutton over the imported and frozen meats. Salted meats and tinned meats are useful as supplying a variety in the dietary, but if used too frequently they fail to supply the proper amount of nutrition, become monotonous, and lead to positive dislike and loss of appetite. Similarly tinned vegetables and fruits are to be reckoned as very inferior to fresh ones for regular use. If from any reason, such as the frequent use of preserved foods, a distaste for meat or vegetables is produced, the result will be that the feeling of hunger will lead the boy to satisfy it by eating undesirable things such as sweets, pastry, etc., in excess. These latter appeal to the boyish appetite at all times, and are not in themselves injurious when given in moderation at meals. It is when wholesome and appetizing food is not supplied at table that the habit of eating unwholesome things between meals is developed.

The quality of the food depends greatly on the cooking. As plain cooking is all that a healthy boy's appetite demands, it is not asking too much to say that the food ought always to be well cooked. "Take what you get and be thankful" used to be a common saying in the domestic circle, but now we think that a boy who refuses to eat a raw steak or a charred piece of roast beef is justified, and the seniors who insist on his eating badly cooked food are unworthy of their position of responsibility.

Tea and coffee may be added to the dietaries hitherto given, but should not be taken in excess or too strong. Milk at this age will be taken much more readily if flavoured with tea or coffee. With regard to alcohol for schoolboys, two questions may be asked: first, is it necessary, and secondly is it beneficial? The consensus of medical opinion has decided both these questions in the negative. If then, on physical grounds, alcohol has been considered unnecessary and not beneficial, on moral grounds one can urge with confidence that alcohol should not form part of a youth's diet during school life. The use of alcohol for medical reasons is considered elsewhere.

A system in vogue at certain boarding schools calls for notice. It is that of supplying only light articles of food at certain meals and allowing the boy to supplement those from home hampers or stuff bought at the tuck shop. The youth of twelve or fourteen is allowed to regulate his diet in accordance with his mature experience and likings. As a test of what a boy can eat and digest and still live this method is instructive and interesting, but on every other ground it is strongly to be condemned. While undoubtedly many parents are foolish as regards the way they feed boys and girls, one expects in an educational institution, where the development of the mind is presumably under careful supervision, that the development of the body will be equally carefully supervised. No one has yet suggested that at this mature age a boy should be allowed to decide what his lessons are to be and when he is to do them. But the choice of what and when he is to eat is left to the boy, without experience, without self-control, and without any knowledge of dietetics. School customs die hard, but the early death of this custom would be welcomed by all who have at heart the welfare of schoolboys.

The chief meals of the day should be three in number, breakfast, dinner and supper. Of these the first two should be the substantial meals, while supper should consist of less stimulating material. Both on physical and moral grounds, as Dr. Clement Dukes has pointed out, it is inadvisable that the schoolboy should have a meal of stimulating and strong food a short time before going to bed. A boy should not be set to do any lessons in the morning before partaking of some food, although he may be allowed half an hour in the open air. If at least an hour is to elapse before breakfast he should have, after dressing, a breakfast cupful of hot milk and weak tea or coffee, equal parts, and a plain biscuit or piece of dry bread. A substantial breakfast should follow not more than an hour and a half after dressing. There should be no hurrying over meals, no bolting of the food, and no reading or conning of tasks, but conversation should be encouraged. Three-quarters of an hour at least are to be devoted to breakfast and the after breakfast functions, so that the brain is not taxed at all during that time. The dinner hour will usually follow four or five hours after the breakfast hour. This may prove too long an interval without food for the youthful appetite and, if desired, a piece of bread with an apple, or some such light food, may be given at 11 a.m. The dinner should be composed of two or three courses, and one of these should consist of a good supply of meat and vegetables. The later meals of adult life, afternoon tea and dinner, are at this age to be replaced by supper, which should be taken at least two hours before going to bed. The basis of this meal should be bread and butter, with honey, syrup, or jam, and there may be given in addition an egg, or fish, or plain salad in the case of strong appetites. With three good meals in the day no boy should suffer from hunger or from failure of nutrition from lack of food. While greediness as regards food must be checked in certain cases, as it breeds physical ills if tolerated, one must not allow a healthy appetite to remain unsatisfied on the ground that moderation is a desirable virtue. At many schools in the past the rule was to allow the minimum of food compatible with health; in other words the children were kept in a state of chronic starvation. While certain strong constitutions might stand this without future ill-health accruing, in many cases the future growth and development were permanently stunted. If error there is to be, then at the growing age under discussion let the error be on the side of allowing the maximum rather than the minimum amount of food.

The value of a liberal diet during school life is strongly emphasized by Dr. Clement Dukes, who can speak with authority on the subject. The following articles of food are selected from those given by him as suitable at this age (*School Diet*, 1899)—

Breakfast.—Porridge. Bread. Hot rolls. Butter. Bacon, fried or boiled. Cold boiled ham. Ham or bacon and eggs. Eggs—boiled, poached, buttered or fried. Kidney and bacon. Sausages. Fresh fish, boiled, fried or pickled, such as cod, flounder, haddock, halibut, herring, salmon, smelt, sole, turbot and whiting. Cold meat or cold meat pies. Mutton chops and beef steak. Brawn. Ox-cheek jelly. Milk, tea, coffee, and cocoa.

Dinner.—Soups—made with ox-kidney, sheep's head, shin of beef, ox-tail, meat stock, lentil, pea, artichoke, tapioca, vegetable marrow, or tomato.

Meats—beef, roast or boiled, mutton, veal, pork, steak, haricot mutton, Irish stew, rissoles, curry, rabbit, hare, steak pudding or pie.

Vegetables—all the ordinary vegetables, boiled. Plain salad of lettuce, cucumber, radishes, tomatoes, and watercress.

Puddings. Fresh fruit tarts of all kinds in season. Jam tarts and puffs. Cheese cakes. Mince pies. Apple dumplings. Baked jam or treacle roll. Baked plum pudding. Boiled suet puddings with fresh or dried fruits or jam. Baked milk puddings, such as bread and butter, rice, sago, etc. Shapes, with jam. Fruit jellies. Apple charlotte. Curds and whey. Baked apples. Stewed fruit and rice or tapioca. Pancakes. Macaroni cheese. Cheese, e.g. Cheddar, Dutch, Gruyère. Water to drink.

Supper.—Eggs. Fish. Potted meat. Bread. Butter. Jam. Honey. Marmalade, Treacle. Buns. Cakes. Radishes, lettuces, watercress. Milk, tea, coffee, cocoa.

It will be admitted that the above supplies a sufficiently liberal and varied diet. It should meet all the requirements of the growing body, and even the special weakness of the schoolboy in the matter of sweet things. Although fresh fruit is not included in the above dietary it is to be regarded as an essential part of the daily diet. As regards boarding schools Dr. Clement Dukes says that fresh fruits, cooked or uncooked, might be provided more frequently than they are as an article of school diet. The nutritive value of fresh fruit is not great but the carbo-hydrate matter which chiefly abounds is in a form which appeals to the youthful palate. If fruit were more regularly given to boys there would be less trouble from the consumption of the more injurious articles of the tuck shop. The action of fresh fruit on the bowels and on the blood renders this food material specially suitable for growing boys.

DIET IN THE DISEASES OF CHILDREN

CHAPTER XXVII

DIET IN THE DISEASES OF CHILDREN

By G. A. Sutherland, M.D., F.R.C.P.

General considerations on disorders of digestion.—On entering on the subject of disorders of digestion in early life it may be stated at once that diet plays the chief part both in the causation and in the treatment. So generally is this recognized to be the case that not infrequently a physical examination of the child is not made, and definite disease may be overlooked. Although one will usually be correct in regarding the diet as the important factor in digestive disorders, it is well to remember that similar symptoms may be induced by organic disease, and to exclude any such possibility before proceeding to dietetic treatment. Digestive troubles are largely preventible by the use of proper foods, properly administered. Unless the symptoms come on acutely and, from the point of view of the mother, alarmingly, medical advice is seldom sought at the beginning. Hence, it often happens that a digestive disturbance which might have been easily cured at the onset is allowed to progress so far before advice is sought that prolonged and careful treatment is necessary. Certain domestic beliefs tend to develop gastric disorders in early life. One of these is that, if an infant is not gaining flesh or is wasting, more food should be given. Another is that if vomiting occurs, the food cannot be suitable, and another should be tried. The criterion of health in the domestic circle is not always in accordance with medical views, for it is summed up in one word—fat. A fat baby in a neighbourhood is responsible for much trouble amongst the surrounding infants. Mothers look with envy on this fat child, and promptly proceed to stuff their own babies so as to produce a similar result. A mother will sometimes seek advice about her infant on the ground that it is wasting, which simply means that it is not as fat as some baby she has seen in the street or in a picture. The so-called wasting infant will often be found to be in the best of health. It may be stated generally that ignorance of the simple rules of infant feeding and neglect of them are the chief causes of gastric troubles.

In the treatment of the various symptoms of indigestion, namely, vomiting, flatulence, colic, diarrhœa, and constipation, one will naturally attend first of all to the diet. The food at first should be such as to give rest temporarily to the disturbed digestive system, which is done by regulating the quantity and quality. Later, a normal diet is to be gradually led up to, as the disordered functions are restored. It is as well in the treatment to ignore any statements as to what the child can and cannot take. No one will deny that there is such a thing as idiosyncrasy as regards food in infancy, but cases of this nature are far fewer than is commonly believed, and certainly far fewer than stated by nurses. The stomachs of most infants and children are quite capable of dealing with ordinary food, and the common forms of indigestion are not due to hereditary tendencies or to acquired diseases, but to improper feeding.

In the following pages it will not be necessary to split up the digestive disorders into a large variety of ailments. We shall consider the more common disturbances and the temporary dietetic measures which are called for before a full physiological diet can be used. Special foods may be ordered for special disorders, and it is necessary to limit their use to the period of disease. Many diets will be referred to which, while beneficial in illness, cannot be employed permanently without serious injury to the child. The physiological diets for infants and children in health have been given in a previous section and will not be treated of again in this connexion.

DISORDERS OF THE STOMACH

The stomach is the source of much trouble **in infancy**, and the leading symptoms of disturbance are vomiting, flatulence, and pain. The belching of wind and the regurgitation of food are not necessary post-prandial sequelæ during infancy, although many nurses hold a contrary opinion. Such errors as too rapid or too frequent feeding, which are apt to induce vomiting, must be corrected. The regular regurgitation of food after a meal implies that too much has been taken, and that the stomach has been over-filled. If this is allowed to become habitual, dilatation of the stomach will follow. The treatment should be to reduce the amount given at each meal. In cases of acute indigestion in infants, with pain and vomiting, all food should be stopped, and only sips of hot water or hot barley-water given until some hours after the vomiting has ceased. In all cases of vomiting in infants no food should be given until the stomach has been thoroughly rested for some hours.

When **vomiting occurs an hour or two after a meal**, it is probably due to incomplete digestion of the food which is refused exit by the pylorus. This is a condition which, if it becomes chronic, is apt to be accompanied by pain, flatulence, and wasting. The fault may lie in the nature of the food, or possibly in some idiosyncrasy in the infant's stomach. When these evidences of gastric irritation are present, a condition which is often called gastritis or gastric catarrh, it is essential to find out the cause.

In the case of **breast-fed infants** this may entail an examination of: (1) the mother, (2) the breast milk, and (3) the infant.

(1) It is but too common to find that a woman who does not habitually take alcohol will consume a couple of pints of beer or stout daily when she is nursing, in the belief that she thereby increases her nursing power. The alcohol thus taken may lead directly to indigestion and vomiting in the infant. The substitution of cows' milk for alcoholic beverages in the mother's dietary will often enable the infant to digest the breast milk satisfactorily. If the mother is leading too strenuous a life, as represented in the upper classes by social gaieties, and in the lower by severe physical labour, the milk may be so altered as to

become indigestible. The habits of the mother must be carefully inquired into and regulated. Sometimes the anxiety of the mother over any disturbance in her infant may so react on the milk as to make it indigestible. It is well to reassure her, if possible, as to the nature of the disturbance, and to secure for her that tranquillity of mind which is necessary for successful nursing. One must also make careful inquiries as to whether any other food besides the breast is being given. Many mothers have lost faith in breast milk as a complete diet for infants, and think some "food" is necessary. The cause of gastric irritation in the healthy child of a healthy nursing mother will often prove to be some thick barley-water or patent food or other unsuitable nutriment given with the view of strengthening the infant. When this has been stopped the gastric irritation soon ceases.

(2) An examination of the breast milk may show that it is too rich in proteins, in which case Dr. Eustace Smith recommends plenty of farinaceous and vegetable food for the mother, and a few ounces of barley-water for the infant before taking the breast. If the milk is found to be too rich in fat, a diminution in the amount of food taken by the mother is indicated. In somewhat rare instances the gastric trouble arises from an unusually large size of the fat globules, a fault which cannot be remedied. Overfeeding on the part of the mother is another possible source of trouble in the infant.

(3) An examination of the infant is always called for in order to find out whether there is any local or constitutional disease present which is the cause of the gastric symptoms. It is manifestly useless to expect successful results from diet if organic disease is overlooked. Congenital pyloric stenosis may be taken as an example of local disease, and syphilis as an example of constitutional disease

As regards **bottle-fed infants** one must inquire into the quantity and quality of the meals and the frequency of the feeding times. In many cases when these are properly regulated the stomach disturbance will cease. A common fault is to give the milk too concentrated. The use of improperly prepared barley-water is a frequent cause of gastric disturbance. In some cases whole barley is used and boiled down into a thick mass which is added to the milk. In other cases ground barley is boiled and added to the milk. Both these methods are unsuited for infants under the age of nine months, who cannot digest a quantity of unconverted starch. The barley will not only remain undigested itself but will cause so much gastric disturbance as to interfere with the digestion of the milk. The use of tinned foods and "infants' foods" is also a common cause of gastric trouble, although as a rule they are more apt to induce intestinal indigestion. Reference may also be made to the habit in certain classes of giving young infants a taste of what is going at the family table, some potato, or sausage, or a drop of beer. This method of feeding must be put a stop to.

In other cases it will be found that neither a cessation of improper feeding nor a return to physiological feeding will relieve the gastric symptoms. Other measures will then be called for and will be discussed in connexion with chronic gastro-intestinal indigestion.

In children over two years of age acute gastric irritation is usually traceable to some error in diet. This may take the form of a surfeit of raw apples, ice-cream, strawberries, pineapple, sweets, etc.—one cannot tell what the vagaries of a boy's appetite may be.

The stomach should be rested by a total abstinence from food for twelve hours, only sips of hot water being given. At the end of that time food may be resumed, in small quantities at first, and should consist of some weak chicken or mutton soup. An attack of acute gastric catarrh may sometimes be induced by a severe chill, as from a wetting or cold feet, or prolonged exposure. In such cases all appetite is lost, the digestion is much weakened, and any strong food leads to vomiting. In the acute stage it is not advisable to give much food, as it will simply increase the gastric disturbance. Peptonized milk, albumin water, and weak chicken or veal soup may be given in feeds of three or four ounces at a time. If food of this character is rejected, champagne may be given in doses of half an ounce every four hours, and sips of hot water frequently, if desired. Rectal feeding is rarely called for, as the disturbance is only temporary.

CHRONIC INTESTINAL INDIGESTION

[Syn. Chronic gastro-intestinal catarrh. Chronic indigestion. Marasmus.]

We pass from the more acute disturbances of the stomach to those more chronic affections in which the functions of the stomach and bowels are interfered with. In many cases the correction of errors in diet will serve to restore the disordered functions. In others one has to employ for a time a special diet, suited to the individual case, in order first of all to rest the stomach and bowels and allow of the gradual recovery of the disordered secretions.

I. **In infancy.** In the case of breast-fed infants chronic gastro-intestinal indigestion is not common, save from gross neglect of the rules of feeding. In the case of bottle-fed babies the condition is an extremely common one, and may call for much skill and patience in treatment. The great cause of chronic indigestion in babies is overfeeding. Whenever the infant cries the tendency is to assume that he is hungry and to give more food. The very temporary relief produced by this is soon followed by more discomfort, more crying, and more food. Even if the food is vomited, it is thought that the loss must be made up, and so more food is given. The marvel is not that the child does not thrive, but that he manages to survive. Sooner or later the overtaxed digestive powers break down. The infant wastes, becomes restless and peevish, and sleeps badly. Colicky pains, vomiting, flatulence, diarrhœa or constipation, and offensive motions with mucus or undigested milk are common accompaniments.

One must make a thorough inquiry into the history of the past feeding. The freshness of the milk, the cleanness of the feeding-bottles, the amount of diluent, cream, and sugar used, the temperature of the milk, the frequency of the meals, the time spent at a meal, the state of the appetite—all these points must be inquired into so as to detect any fault which may have originated or maintained the indigestion. One of the most prolific sources of intestinal trouble in infancy is the use of condensed milk and proprietary "infants' foods." These foods are easily prepared, do not quickly go bad, and "stay down" as a rule without much difficulty, so that by a large number of ignorant mothers they are preferred to fresh foods. The infants apparently thrive on them for a time, become fat and beautiful in the maternal eyes, and are duly admired by relatives. They are not, however, suited to an infant's digestive powers, and being largely composed of sugar and starch, they tend to ferment in the intestine, so that flatulent indigestion is a common result. As we are not yet able to adapt an infant's digestion to the ideas of artificial food manufacturers, the best plan for the present is to follow the guidance of nature as far as possible. The safest and the simplest method of treatment in these cases of patent food indigestion is to discard the food altogether and to return to physiological feeding.

In the presence of chronic gastro-intestinal catarrh which does not yield to simple dietetic treatment, or which is in an advanced stage, some modifications in the ordinary feeding are called for. Further dilution of the milk may be tried. One part of milk may be mixed with two or three or four parts of lime-water, and given in small quantities every two hours by day and every four hours by night. In some cases it will be advisable to give nothing but lime-water during the night so as to rest the alimentary tract more thoroughly. As toleration is established, the strength of the milk mixture may be gradually increased. In other cases the citrate of soda method, as suggested by Wright and practised by Poynton, seems to be of service. It consists in the addition of citrate of soda to the milk, one or two grains to each ounce of milk in the mixture as diluted for use with plain or barley-water. The curds formed in the stomach are believed to be rendered more digestible, and the vital properties of the milk are not injured in any way.

Special measures may be required to overcome the **indigestibility of the proteins** of cows' milk. For this purpose whey may be used. It is prepared by adding a drachm of liquid rennet to half a pint of warm milk. After the mixture has been thoroughly stirred it is allowed to stand until firmly coagulated. The curd is then broken up thoroughly and the whey is strained off through muslin or a strainer. When whey is kept any time, or is to be mixed with other food, it is advisable to heat it to 160° F. in order to destroy the rennet ferment. One can begin with equal parts of whey and water, and give small quantities every two hours by day. Whey is usually well tolerated by the youngest infants, and one can gradually increase the strength of the food by giving it undiluted, then by the addition of some sugar or malt, and later of cream. The protein element in the diet may be increased by adding ten to fifteen drops of raw meat juice or white of egg to each feed or alternate feed. Another method of meeting the difficulty which these patients have in digesting the milk albumins is by the use of peptonized milk. This may be done by a pancreatic extract, or by peptonizing powders, or by peptogenic milk powders. The details of the method of preparation are supplied with each packet. The last named is the most suitable for young infants, as the resulting product resembles closely breast milk in its chemical composition. As a rule the peptonizing process should not be prolonged beyond half an hour, and whole milk without any extra cream should be used. Infants take and digest peptonized milk well, but its nutritive properties are certainly inferior to those of fresh milk. As the digestion improves the peptonizing time should be gradually reduced from thirty to twenty and ten minutes.

Sometimes **the fatty element** in the food is the **cause of indigestion.** This may arise either from an excessive amount of fatty material having been given, or from the special difficulty which the infant has in digesting fat. In the former case a reduction in the amount of fat in the diet will probably effect a cure. The symptoms associated with fat indigestion are vomiting, toxæmia, and possibly convulsions. An excess of fat may be found in the stools, which are offensive, white or grey in colour, and contain small yellowish masses which are often mistaken for curds. These masses may be distinguished from curds by the facts that they are soluble in ether and burn readily with an odour of butter (Holt). The fat of cows' milk may be the source of trouble, and Finley Bell suggests in such cases the use of goats' milk, in which the fat more closely resembles that of breast milk. Stern believes that the high percentage of volatile fatty acids in cows' milk as compared to human milk is the cause of fat indigestion. He recommends the addition of yolk of egg to skimmed milk suitably modified. Yolk fat yields very little fatty acid, and the large amount of lecithin which it contains acts as a stimulant of the whole nervous system. An average yolk contains about six grammes (90 grains) of fat, so that roughly speaking, an ounce of (20 per cent) cream corresponds to one yolk as regards fatty content. The yolk should be perfectly fresh and given raw.

Cases of fat indigestion may also be treated by means of buttermilk, which is very similar in composition to skimmed milk. It differs in the markedly acid reaction, due to the lactic acid fermentation, and in the casein formed in the stomach, which is casein lactate instead of calcium casein. Casein lactate is not acted on by rennin and consequently does not form dense curds in the stomach. Lactic acid is believed to check the growth of certain putrefactive and pathogenic bacteria in the gastro-intestinal tract, and to aid in the peptonization of the milk. These combined advantages have led to the successful employment of buttermilk in cases of chronic indigestion. Buttermilk may be obtained in many country places fresh from the churn, and this is probably the most efficient form in which it can be given. In towns it is sold by many of the large dairy companies, or it may be artificially prepared at home by the use of "lacto-bacilline." Lacto-bacilline is fluid milk which contains the bacillus acidi lactici. It is used in the following way to prepare "lactated milk" (Batten). Fresh milk is boiled, and then cooled down in a sterilized stoppered bottle to 96° F. One tube (about 3 drachms) of lacto-bacilline is added to 11 oz. of milk. The milk is kept in a water bath at a temperature of 96° F. for seven hours, during which time it becomes sour, and a slight clot is formed. It is next cooled on ice for twelve hours, at the end of which time it has become a creamy fluid and is ready for use. Batten found that children who could not take any other form of milk could retain and digest lactated milk. When fat indigestion is the source of trouble one can use either fresh buttermilk or the lactated form made from skimmed milk. In both cases the buttermilk is only a temporary measure, and fat in some form must be added to the diet later on. The addition also of large quantities of lactic acid is believed to affect injuriously the chemical metabolism of the system, if this method of feeding is unduly prolonged. Separated milk, i.e. milk with all the cream removed, may also be employed as a temporary measure in cases of fat indigestion.

One or other of the above measures will usually prove effective, but in exceptionally difficult cases of chronic indigestion one may employ condensed or dried milk. A good brand of sweetened condensed milk, with all the original cream present, should be obtained. It must be given well diluted, one teaspoonful of the milk to 4 or 6 oz. of water to begin with, according to the age and state of the infant. The strength is to be gradually increased as toleration is established. Again one of the dried milks, such as plasmon, or somatose, or sanatogen may prove useful. The dilution, to begin with, should be one teaspoonful of the powder to 6 oz. of water. Why it is that milk in these forms should apparently be better tolerated than fresh preparations is difficult to explain, but it is probably due to some change in the proteins which are rendered more digestible. In the case of infants under six months starchy foods are not to be recommended for digestive troubles. After that age they may sometimes be found useful, possibly from their mechanical action in reducing the size of the curds. The flour of barley or oatmeal or wheat may be used. A tablespoonful of one of these is to be boiled in a pint of water for an hour. Of this half to one ounce may be mixed with an ordinary feed of milk and water. At this age also one may sometimes aid the digestion of the milk by adding a small quantity of one of the converted starch preparations, such as Mellin's food, care being taken that not more than a half to one teaspoonful be given as a meal.

These are some of the more common dietetic methods now employed for meeting the digestive difficulties of infancy. At the outset one must not only decide on the food, but proceed to give it a fair trial. The effect will not be seen all at once, and if the food is varied every few days there will probably be no improvement. At least a week or ten days are required to test the effect. At the same time it is often quite a good plan to combine two of the methods, giving for instance a diet of peptonized milk by day and of whey by night. Both of these preparations are for the same purpose, namely, to reduce the amount of protein digestion in the stomach, and one may be able to tell from the symptoms which is most effective and to act accordingly. A little variety in the diet may also aid the stomach and bowels in recovering their tone.

Perhaps more important than the food is the degree of dilution. The digestive powers are weakened and inactive, and only the weakest foods will be tolerated. Hence the most excellent foods may prove useless simply because they are too strong. At the same time the stomach must not be flooded by large quantities of fluid food. Small amounts frequently repeated are better than larger quantities less often. It is best to begin with 1–2 oz. every hour, or 2–3 oz. every two hours.

One may sometimes be at a loss to know whether the food is really agreeing with the infant. Favourable signs are a cessation of the whining and restlessness, the recurrence of smiling, and longer and quieter periods of sleep. The subsidence of the active gastro-intestinal symptoms, flatulence, colic, etc., and an improvement in the quality of the stools are favourable indications. A gain in weight is not to be looked for at once, as the diet in the early stage is one to rest the alimentary tract, not to fatten the child. It is not until all active signs have subsided and a more nourishing food has been adopted that the nutrition of the infant will improve. In the early stages also the amount of fat must be reduced to a minimum, owing to its indigestibility. In the convalescent stage, on the other hand, cream and cod-liver oil are of the greatest benefit in building up the patient.

The duration of the special feeding will depend on the severity and length of the illness. It must always be kept in mind that however useful as temporary measures, these methods of feeding should not be prolonged further than is necessary, because dangers lurk in the way. As soon as possible the infant should return to a diet of fresh cows' milk and other materials suitable to its age, as already described. The return to normal diet must be made gradually, by introducing one or two feeds of fresh milk in the course of the day.

The extreme form of malnutrition from gastro-intestinal catarrh is known as **marasmus.** Some infants are born with very low vitality and with an alimentary tract which is apparently incapable of dealing with any form of food, but such cases are rare. In the great majority of marasmic patients the underlying cause is improper food and feeding. The vital powers of the infant may be at the lowest before advice is sought, and a diagnosis of tabes mesenterica is often erroneously made. The methods of feeding, as already described, may fail. In such cases a wet nurse is the best line of treatment. If the infant is too weak to take the breast, the milk may be drawn off and given with a spoon. Failing to obtain a wet nurse one has to depend for a time on brandy and meat juice. A drachm each of brandy and fresh meat juice may be mixed with 6 oz. of water. Of this mixture 1 oz. may be given every hour for an infant of three months, eighteen feeds being given in the twenty-four hours. In place of the meat juice one may use weak chicken or veal soup. After a few days' trial of this some whey or peptonized milk may be given occasionally, and an attempt made to establish toleration of milk food. Another mixture which may be tried in these cases is composed of white of egg, 2 drachms, brandy and malt extract, of each 1 drachm, and water to 6 oz. This may be given in the same quantities as the meat juice mixture. White-wine whey may also prove serviceable in these cases, as used by Myers and Still. Ten ounces of milk are brought to the boil and 2½ oz. of cooking sherry are added. The mixture is again boiled, removed from the fire, and allowed to stand for three minutes. The curd is then strained off and the whey is ready for use. Analysis of this whey shows the following composition: protein (almost entirely lactalbumin) 0·45 per cent; fat, 0·95 per cent, and sugar, 5·00 per cent. The amount of alcohol in 1 oz. corresponds to that in twenty-five drops of brandy. Myers and Still give one tablespoonful of the whey every half-hour or three-quarters of an hour to an infant of six weeks, and gradually alter the amount and times until 2 oz. are taken every two hours. The maximum at a feed is 2½ oz. The acidity (tartaric and acetic acids), the nature of the protein, the carminative ethers of the sherry, and the stimulating effect of the alcohol render this whey suited to the weak digestion and exhausted vital powers of a marasmic infant. It should not be given as the sole food for more than a week or ten days. The effect of the alcohol in the mixture must be carefully watched, as it is intended to act as a stimulant and not as an intoxicant. When, as often happens, the mucous membrane of the alimentary tract has become atrophied and functionless, the results of treatment are very disappointing.

II. **After infancy.**—In the case of chronic gastro-intestinal indigestion in children beyond the age of infancy, one must also recognize that probably the same factors are at work, namely, overfeeding and improper food. The course of events is often as follows: A child with a healthy appetite is allowed too full a diet, with an excess of farinaceous foods and sugar. This excess of carbo-hydrate material is often given in such fluid form that the teeth are not used, the food is swallowed rapidly, and goes down so easily that much larger quantities are consumed than if thorough mastication had been necessary. By and by symptoms of intestinal indigestion appear. The child looks pale, and begins to lose flesh. A course of feeding-up is begun, and beef juices, patent foods, cream, etc., are added to the already over-full dietary. Finally there comes a complete breakdown of the entire digestive system. The course of treatment to be adopted is to give the overtaxed intestine as much rest as possible. Peptonized milk, or whey, and freshly-made mutton, veal or chicken soup are to be given in small quantities every few hours. A word of warning must be given to the cook that she is not to make the soup as "strong" as possible, but of the strength of ordinary dinner soup. When the intestinal rest has led to the recovery of appetite, solids may be begun in the form of fish, chicken, or mutton, plainly cooked, with a little bread crumb or bread sauce. After toleration for these has been established, some carbo-hydrates may be added to the dietary, toast, milk pudding, and plain biscuit. Last of all the stage of fatty foods is reached—butter, yolk of eggs, cream, and cod-liver oil—and the building-up process will then go on rapidly. The length of time taken to secure complete recovery will depend on the time during which the improper feeding has lasted.

To prevent a recurrence of the condition one must arrange for the future a dietary which contains (1) a sufficient amount of hard food which requires chewing, and (2) a limited amount of farinaceous foods and sugar. For the former purpose beef or mutton or chicken should not be given to children in a minced or pounded form, but plainly cooked. Toast, rusks, biscuits, raw apples entail an amount of chewing which is good for the digestion and the teeth. Further, the child's appetite will be satisfied more readily after chewing food thoroughly, and there will not be the same tendency to swallow down large quantities of food as in the case of fluid milk puddings. When a child has had a sufficient amount at a meal and still complains of hunger, a raw apple or a hard biscuit will be better than another helping of sweet pudding. The excessive use of carbo-hydrates is very marked in the present day. Many children are allowed to consume far too much bread and butter and sweets. These must be strictly limited. Finally, the coaxing of a child to eat more food must be absolutely forbidden. No child should ever be coaxed to eat, and much harm is often done by this line of treatment on the part of over-anxious parents and nurses.

FOOD FEVER

This is a disorder which has been specially described by Dr. Eustace Smith as consisting of "an attack of fever which comes on suddenly, is accompanied by signs, more or less pronounced, of digestive disturbance, lasts in its acute form for several days, and may linger on in a modified degree for some weeks." The subjects of this affection, according to Dr. Smith, are usually children of either sex between the ages of three and twelve years, of a neurotic temperament, and liable to chills and acute gastric catarrh. These accompanying conditions may be ignored here, as apparently the important element both in the preventive and the curative treatment lies in the diet. An attack begins with headache and is frequently characterized by vomiting or diarrhœa, always by some kind of digestive upset. The child shows a disinclination for play or exertion of any kind ; the temperature is raised to 101°, or it may be much higher ; the face is dull and pasty in appearance, and the tongue is dirty. Examination shows extension of the stomach resonance upwards, enlargement of the liver, and thick, very acid, or high-coloured urine. The children, as a rule, make no complaint of bodily discomfort, but are fretful and irritable in the day, and at night lie awake or sleep badly, groaning and tossing from side to side. Often they do not care about their food, and sometimes it is most difficult to make them eat anything at all.

Although the attack may be started primarily by acute gastric catarrh, Dr. Eustace Smith believes that the fever is maintained by reabsorption from the bowel of injurious products of decomposition. The appearance of the stools shows that fermentation has been taking place, and it is a natural inference that some of the products of this fermentation must be absorbed into the blood. Dr. H. Davy also concludes that the fever is due to an auto-intoxication from the products of fermentation of particular mixtures of starchy foods.

All are agreed that the diet is of the greatest importance, and the following are the lines of dietetic treatment recommended by Dr. Eustace Smith. Articles of food which are capable of undergoing an unwholesome fermentation in the bowels must be forbidden. Starches and sweets should be given with caution, and a combination of starch with milk, such as is found in the ordinary milk pudding of the nursery, rice, sago, tapioca, etc., should be strictly forbidden. Milk itself, except in very limited quantity, is harmful, because of its tendency to ferment, and in persistent cases milk should be excluded entirely from the diet. Acids, such as are found in baked apples, grapes, oranges, and lemonade, must be condemned, as they tend to promote fermentation. " The proper diet for these children consists of mutton, poultry, white fish, well-boiled green vegetables, and eggs. They may have plenty of butter, with stale bread, toast, and rusks. The salted foods are good, such as bacon, ham, and tongue ; bloaters also and sardines, and the pastes made of anchovy, bloater, and shrimp may be allowed." Although these foods are not all in common use in the nursery, Dr. Smith finds that they are harmless, and that the pastes make good substitutes for marmalade and jam.

It is plain that such a diet cannot be continued permanently nor does it appear necessary that it should. Dr. H. Davy has found that after a time farinaceous and other starchy foods may be given in small amounts and gradually increased as toleration is established. He is inclined to trace the attacks of fever to the fact that the pancreatic digestion is not proportionate to the age of the child. As the child grows older the power of his pancreatic digestion increases, and so the cause of the fever gradually ceases. The special dietary required may be carried on for six or twelve months until the pancreatic secretion is properly established.

ACIDOSIS OR ACID INTOXICATION

The condition of acidosis or acid intoxication may be considered here, first because it is believed by many to be the result of faulty metabolism associated with the diet, and secondly, because the symptoms are largely concerned with disturbance of the gastro-intestinal tract. Clinically, the form of toxæmia under consideration is recognized from the smell of acetone in the breath, from the presence of acetone in the urine and in the vomit, and in severe cases from the presence of diacetic acid in the urine. The symptoms of poisoning may be mild or severe, and probably many mild attacks are recovered from without the condition being recognized. These milder attacks are frequently put down to "biliousness," or constipation, or acute gastric catarrh. In severe cases the leading symptoms are sudden and uncontrollable vomiting, persisting for some hours or days, and accompanied by constant nausea, retching, and great prostration. One form of acidosis in childhood is of unknown origin, and is variously described as "periodic vomiting," "cyclic vomiting," or "recurrent vomiting." Another occurs after the administration of an anæsthetic. We shall consider only the former condition here.

The subject of the dietetic treatment, preventive and curative, of these attacks of periodic vomiting is a very difficult one, owing to our ignorance of the pathology of the affection. This is shown by the number of different views which have been brought forward. At one time the acids in the system were ascribed to the excessive breaking down and imperfect metabolism of proteins. More recently it has been held that the imperfect oxidation of fat in the system is the cause of acidosis. This faulty metabolism may affect both the fat stored in the tissues and that taken in the food. As the carbo-hydrates contain a large amount of oxygen, they should be useful in acidosis from faulty metabolism of fats. This is what actually happens in the acidosis of diabetes, which can be checked by giving carbo-hydrates. On the other hand, Dr. Eustace Smith believes that many cases of periodic vomiting are due to excess of carbohydrates, and the accompanying intestinal fermentation. Dr. Holt also recommends that, in the intervals between attacks, all sugar and sweets should be excluded from the diet, and that the amount of starchy food should be carefully limited. Thus the condition of acidosis has been ascribed by different writers to (1) an excess of proteins, (2) an excess of carbo-hydrates, and (3) an excess of fats in the diet. The excess, however, is not an absolute one, but only relative to the power of the individual to deal with these substances.

Brackett, Stone, and Low say that the formation of acetone is due to faulty metabolism with the formation of free fatty acids, and is largely dependent on a reduction of the carbohydrates and proteins in the diet, and general subnutrition. It may be the body-fat or the food-fat which is the source of the acetone, but the immediate cause is the disturbance of the metabolism. J. A. Kelly says there is some toxæmia present, but whether it is due to the presence of volatile fatty acids, to the rapid destruction of protein matter, or to the rapid elimination of the alkalies it is impossible to say. Langdon Brown says that in acidosis there is a relative starvation of the tissues, and that, broadly speaking, they are being starved of carbohydrates. As a result of this there is excessive disintegration of the fatty tissues in the body. The further production of these acid bodies should be prevented as far as possible by cutting off fat in the diet, and by adding carbo-hydrates.

From the diversity of the views which have been referred to, it is plain that the time has not yet come for any definite or dogmatic statement as to what the diet ought to be in a case of periodic vomiting. During an acute attack the question of diet hardly arises, because the vomiting is so severe that all appetite is lost, and no food can be retained. At this stage thirst is the chief complaint, and the patient may be given frequent sips of hot or cold water, soda-water, or barley-water. Even plain fluids are usually quickly vomited, but there is a certain relief supplied to the patient. If after twenty-four hours the patient is still unable to retain any food by the mouth, nutrient enemata composed of peptonized milk (1 oz.), glucose (half an ounce of a 10 per cent solution) and brandy (half a drachm) may be given every four hours. As soon as food can be retained in the stomach it seems advisable to avoid all fatty material, and to give only digestible proteins and carbo-hydrates. Plasmon, Allenbury's food, and peptonized milk may be given at first, and later one may go on to oatmeal-gruel or porridge, bread, farinaceous puddings, and sugar. As a matter of clinical experience it may be stated that there is no gradual return of the appetite in typical cases of periodic vomiting, but the attack ceases suddenly, and the patient after sleeping wakes up ravenous and demands food. Further, whatever food is given will be eaten and retained and digested. It is none the less advisable to maintain the above diet for a few days, and thus aid the elimination of the acids from the system.

After an attack has subsided, and in the intervals between attacks the diet usually recommended is one containing an average amount of proteins and carbo-hydrates, and a small amount of fats. All the foods should be simple and digestible, and should be given in such amount as not to overtax the digestive organs. This line of treatment cannot be said to be very efficacious in curing the affection. The fact that in many cases the attacks are slight and pass off after a few days' low diet, or, if more severe, recur only once in six or twelve months, render any exact conclusions as to the effects of diet very difficult.

The present writer has had the opportunity of watching closely two cases in children aged seven and twelve years. In them the attacks were very severe and very frequent. The patients were both extremely emaciated and extremely neurotic. Various diets were tried, including those of an almost purely protein character, and those of carbo-hydrates only. Again, various articles were omitted from the diet for a time, such as milk, then eggs, then meat, etc. No benefit from these various dietetic changes could be observed. When the patients were put on an ordinary full hospital diet they seemed to do just as well as on a restricted one, and further, they gained some flesh. It was then thought that the latter advantage might be still further increased by the Weir-Mitchell system of overfeeding, massage, rest and isolation. The following was the diet taken during a period of six weeks.

Food in Twenty-four Hours (patient 12 years old).

5 a.m.	Cocoa and milk, ad lib.; bread and dripping.
7 a.m.	Cream ℥½; milk, ℥iij; water, ℥j.
9 a.m.	Milk, ℥v; malt extract ʒ½; water, ℥ij; bread and dripping.
11 a.m.	Cream, ℥½; milk, ℥iij; water, ℥j.
1 p.m.	Meat; pudding, with cream, ℥j; bread and dripping.
3 p.m.	Milk, ℥v; malt extract, ʒ½; water, ℥ij.
5 p.m.	Cocoa and milk; one egg; bread and dripping.
7 p.m.	Cream, ℥½; milk, ℥iv; water, ℥j.
9 p.m.	Raw meat juice, ℥j; water, ℥j; bread and jam.
1 a.m.	Raw meat juice, ℥j; water, ℥j.

During this course of treatment the patient increased in weight from 43½ lb. to 56 lb., a gain of 12½ lb. There were no attacks of vomiting, and she looked the picture of health. This was the longest interval she had had of freedom from vomiting attacks for some years. The patient was not cured, for on her return to the home surroundings the vomiting returned, and the wasting again set in rapidly. The above experience in two cases is rather against the view that any special food element (protein, carbo-hydrate, or fat) is the cause of the trouble, and supports the view, held by many, that the affection is really to be classed as a neurosis, comparable to migraine. That metabolism is at fault may be admitted, and more especially the action of the liver, but it would appear, in some cases at least, to be dependent primarily on a disturbance of the central nervous system. One may do harm rather than good by a spare diet, or by a non-nutritive diet, or by any diet based purely on the chemical problems of this affection. If a chronic case fails to improve under a rigid and limited diet, it may be advisable to try the effects of a full diet as outlined above.

DIARRHŒA

Diarrhœa is one of the commonest signs of intestinal disturbance in infancy and childhood. A large number of cases will be found to be associated with improper feeding. Diarrhœa may be one of the chief symptoms of chronic intestinal indigestion, which has already been considered. In infants overfeeding, too frequent feeding, and improper food will often cause diarrhœa, with or without the addition of gastric symptoms, vomiting, etc.

The **preventive treatment** consists in the use of proper food for infants and children. Of special importance is the freshness of the food, milk, fruit, etc., for the most severe cases are those in which some decomposition has taken place in the food. This is the cause of the most fatal form of diarrhœa in early life, namely, the acute summer diarrhœa of infants. It is inadvisable in the case of breast-fed babies to wean during the hot season, as diarrhœa is very easily induced by a change of diet at this time. Whatever views one may hold as to the relative advantages of boiled and unboiled cows' milk, it may be safely asserted that in hot weather all cows' milk for children's use should be boiled for two or three minutes and then kept on ice in a closed or covered vessel. The greatest cleanliness should be observed in connexion with the feeding-bottles, and no "dummy" soothers should be allowed in the infant's mouth. The tendency to give young infants some fruit, which is so common amongst nurses during the hot season, should be severely discouraged as being distinctly dangerous. In older children the indiscriminate use of sweets and sweet cakes is responsible for many cases of diarrhœa. While fruit is good for them, care must be taken to see that it is ripe, as both unripe and too ripe fruit is a fertile source of diarrhœa.

The **treatment** of slight attacks of diarrhœa in breast-fed babies consists in diminishing the frequency of the feeding times, or the amount given at each meal. Sometimes, although rarely, the maternal milk does not suit the child, and chronic diarrhœa results. If one cannot correct the breast milk by treating the mother, it may be necessary to put the child on some other food. In the case of bottle-fed babies diarrhœa is often due to an excessive amount of starchy material in the diet. One must therefore remove this source of trouble, which usually takes the form of some patent food, and put the child on to a proper dietary. A few days of low feeding and plenty of water to drink will cure these mild or chronic cases of diarrhœa in infants. The same applies to the case of older children where the dietetic element will be found at fault.

The most severe form of diarrhœa in early life is the **acute summer diarrhœa** of infants. It is essentially a disease of bottle-fed babies, or of those who are receiving some food in addition to the breast milk. The origin of the disease is traceable to certain organisms in the food, chiefly in cows' milk, which multiply and cause intense irritation in the stomach and intestines. The exact method by which the milk is contaminated is unknown, but there is much evidence in support of the view that flies are the chief means by which the milk is infected. In many houses milk, whether fresh or tinned, is open to this source of contamination owing to its being left in an exposed condition, and wherever milk is there flies will gather.

During the summer printed papers containing the following instructions are given to all the mothers attending the Paddington Green Children's Hospital.

"In hot weather milk quickly turns sour or becomes tainted by dust, dirt, and flies, and may easily bring on diarrhœa unless the following **precautions** are taken :—

"Buy the milk *twice* a day—*not once* only—and get the best cows' milk you can, as cheap milk is always dangerous.

"Boil it at once for one or two minutes.

"Then place it in a covered vessel in a basin of cold water and keep cool. The milk must be covered over to prevent dust and flies from reaching it.

"Always taste the milk, in a spoon, before putting it in the bottle, to see that it has not turned sour. Do not put the teat in your own mouth at all.

"Do *not* keep any milk left in the bottle for the infant's next meal. Use it for yourself or the rest of the family.

"The bottle should be boat-shaped with an india-rubber teat, but *no* long rubber tube.

"The bottle should be scalded out after use, and cleaned with a bottle brush, which should be boiled immediately before using.

"After each feed the nipple should be turned inside out and washed, and kept with the bottle in cold water.

"Good milk is often spoiled by dirty bottles.

"When fresh cows' milk cannot be obtained, or the milk has turned sour, use the best sweetened condensed milk.

"Get small tins, as after the tin is opened the milk will soon go bad.

"Cover an opened tin with clean muslin or butter cloth to protect it from dust and flies, and keep in a cool place.

"In any case of sudden diarrhœa or vomiting stop the milk at once, and give only plain water which has been boiled, or barley-water.

"In hot weather do not keep bones, stale vegetables or fruit, and other rubbish for the dustbin in the room or house. Rubbish breeds flies, and flies poison the food they settle on."

In acute summer diarrhœa milk in any form must be stopped at once. It is especially dangerous in this disease, because it usually conveys the poison which is the starting-point of an attack, and is a good medium for the further growth of the organisms in the alimentary tract. We have therefore to find some temporary substitute during the time that attention is being devoted to thoroughly clearing out the gastro-intestinal tract. In very acute cases the best plan is to stop all food entirely and to give only boiled water or barley-water or rice-water for twenty-four or forty-eight hours. This usually meets with a strong protest in the domestic circle on the ground that the infant will be starved to death. The anxious mother may be assured that the infant is incapable of digesting or absorbing any food, and her attention may be directed to the motions, where the milk given has appeared quite undigested. As the thirst is usually very great, water should be administered frequently, every hour or two hours, but in small quantities as vomiting is so easily induced. If the vomiting is very severe it may be necessary to give only one or two teaspoonfuls of water at intervals of fifteen or twenty minutes. The great loss of fluid produced by the diarrhœa often leads to a condition of collapse, of shrivelling up of the tissues, and of cardiac weakness. Fluids cannot well be administered per rectum to infants, but the subcutaneous injection of normal saline fluid (1 drachm of common salt in a pint of boiled water) will prove beneficial. A Southey's or other small trocar may be used, and the *hot* sterile fluid should be allowed to flow by gravitation into the loose tissues of the axilla or abdominal wall. From 6–8 oz. may be injected at a time, and the fluid should be allowed to enter slowly, so as to avoid the risks of sloughing or hæmorrhage. The tissues will absorb the fluid rapidly, and the restorative effect on the patient is often marvellous.

A little brandy is probably beneficial as a stimulant if given well diluted—a teaspoonful in half a pint of water during the day, and the same amount during the night.

At the end of thirty-six or forty-eight hours, or when sufficient time has been allowed for the thorough emptying of the bowels by medicine, a beginning should be made with food in the shape of albumin water, or weak veal, mutton or chicken soup. Here the rule must be to proceed very slowly and gradually, watching the effect. Albumin water may be made at first of the strength of half an ounce of the white of egg to half a pint of water or barley-water, and this may be rendered more palatable by the addition of 2 drachms of extract of malt. Similarly an ounce of soup may be diluted with 5 oz. of water. As regards the feeding the rule should be to feed every two hours by day and not oftener than every four hours by night, and only to give small quantities at first—say 1 or 2 oz. If the thirst is great, no harm is done by giving the infant water freely between the feeds. This modified diet may be carried on for one or two days, until the diarrhœa is somewhat lessened, and the motions are not of a purely mucous character. If the albumin water is found suitable there is no occasion to give the soup, but in some cases the soup seems better tolerated.

The third stage is reached when we commence tentatively a return to milk food. A trial of milk in one or other form should be made by alternating it with the albumin water. Of the various forms in which milk may be used at this time the following represents a scale of digestibility: (1) peptogenized milk (without added cream), (2) whey, (3) condensed milk (diluted with twenty-four parts water), (4) equal parts of cows' milk, lime-water, and barley-water. Citrated milk (gr. 1 of citrate of soda to each ounce of milk) may also be found suitable. It is not necessary to take every infant through these four stages, but in one patient one form of milk will be found to agree best, and in another patient some other form. If the milk provokes a recurrence of vomiting or diarrhœa, it must be at once stopped. Toleration will not be readily established and in no case must an attempt be made to feed up the patient rapidly. The chief points about the dietetic treatment are: (1) to give no food until the stomach can retain and digest it, (2) to begin with very weak foods, and very small meals, and (3) to let the patient have as much water as he can retain, so as to help in washing out the bowels.

CONSTIPATION

Constipation is a common trouble in infants, both breast-fed and bottle-fed. Without being immediately injurious to the child's health, it is the source of much discomfort, and may induce a permanent weakening of the bowel and of the digestive functions. The most common cause of constipation is some fault in the quality or quantity of the food, and as a first step in the treatment the dietetic habits must be carefully inquired into and regulated. In the case of breast-fed babies this will also include an investigation into the mother's habits and dietary. Very often in the case of young infants the drinking of some plain water or barley-water between feeds may serve to relieve constipation. In the case of bottle-fed babies a little extra fat may be added to the diet in the shape of a teaspoonful of cream or olive oil thrice daily, which has a lubricant action on the bowel contents. In other cases some additional sugar in the shape of malt extract will prove effective. The juice of grapes or oranges, a tablespoonful diluted with water, and given in divided doses, will often relieve constipation. After the age of six months some farinaceous food in the shape of oatmeal or barley gruel may have a beneficial stimulating effect on the bowel wall.

In older children the prolongation of a soft, pappy diet after the teeth have been cut, and the use of too refined foods, are apt to be followed by constipation. Intestinal peristalsis is weakened when there is no solid residue in the bowel to call it into action. The fluid, non-irritating contents of the small intestine fail to stimulate the colon, and accumulate there as soft masses, which tend in time to become inspissated. Hence it will be found useful in many cases of constipation to order foods which contain some irritating particles, such as porridge, whole-meal bread, figs, etc., or which contain a considerable amount of indigestible residue, such as salads, green vegetables, tomatoes, and raw apples. Care must be taken that these substances, vegetables and fruits, are not given in excess, as the digestion may be impaired in the attempt to relieve constipation. Many growing children are constipated because they do not drink enough water. They never complain of thirst and so no fluid is given them save at meal times. Frequently at meals very little fluid is taken. In such cases from a pint to a pint and a half of water should be drunk daily between meals, commencing with a cupful of cold water on rising. Fresh fruits such as oranges and grapes may be regarded as fluids, and the organic acids in them lend an additional aperient action. Fats and oils have a lubricating effect in the intestine, and prevent the inspissation of fæces, so that plenty of beef or mutton fat, salad oil, and nuts may relieve constipation, especially when the motions are hard and dry.

ABDOMINAL TUBERCULOSIS

There are three chief forms in which abdominal tuberculosis is manifested in early life. First, there may be tuberculous enteritis, an ulcerative form of inflammation affecting chiefly the lower part of the small intestine, the cæcum and the colon; secondly, there may be tuberculous mesenteric glands, a condition which is known clinically as tabes mesenterica ; and thirdly, there may be tuberculous peritonitis. It is possible that any one of these types may occur alone, but as an isolated condition tuberculous enteritis or tabes mesenterica is distinctly rare in childhood. The commonest form met with clinically is tuberculous peritonitis. At the same time, while tuberculous peritonitis overshadows the others by its frequency and by the prominence of its symptoms, it is to be viewed as a result of tuberculous infection of the bowel. In some cases it may be that infection comes from the thoracic glands along the lymphatic channels, or from other tuberculous deposits viâ the blood stream, but such are not examples of abdominal tuberculosis, pure and simple.

Abdominal tuberculosis as a primary disease is not often met with during the first two years of life. Tabes mesenterica is not a common disease of infancy. "Consumption of the bowels," which is such a popular diagnosis, is most frequently a misnomer for chronic intestinal indigestion and diarrhœa the results of improper food and overfeeding. At the same time, from the age of six months one may meet with typical and severe cases of abdominal tuberculosis. The majority of the cases occur after the age of two years. The symptoms of tuberculous enteritis may be very slight, or there may be severe and persistent diarrhœa, with the passage of blood and mucus, and with a considerable degree of irregular pyrexia. The symptoms of tabes mesenterica may be wasting only, and unless one can make out definitely a mass of enlarged glands about the mesentery, the diagnosis must remain uncertain. Tuberculous peritonitis, on the other hand, is usually a well marked affection, and as it is usually accompanied by the other two conditions, we shall in the following remarks discuss abdominal tuberculosis under the name of tuberculous peritonitis.

The **preventive treatment** of **tuberculous peritonitis** consists in the use of wholesome fresh food as the diet, and of the maintenance of a healthy condition in the alimentary canal. The dread of tubercle-laden cows' milk has affected the profession and the public for some years, and elaborate methods of sterilization were introduced to destroy not only every tubercle bacillus, but also every spore. This was probably effected, but at the same time the nutritive value of the milk was destroyed. For practical purposes it has been found that boiling the milk for one or two minutes will destroy the bacilli, which as a rule are not abundant in cows' milk, unless the cow's udder is the seat of active disease. As a matter of clinical experience, it has been found that tuberculous peritonitis may occur later in children who have been fed entirely at the breast for nine or ten months. While it is most important that children should have tubercle-free food as far as possible, there is no evidence to show that the subjects of tuberculous peritonitis have been swallowing more tubercle bacilli than their neighbours who have escaped. It may be assumed that in town life and in crowded areas every child consumes in the food a considerable number of tubercle bacilli, both living and dead. The real risk lies in an unhealthy condition of the alimentary canal, which may allow of the penetration of the bacilli. Consequently the troubles of infancy and childhood—flatulence, diarrhœa, chronic intestinal catarrh, and other disturbances of the gastro-intestinal tract—in so far as they weaken the self-protecting and resisting power of the bowel, may predispose to abdominal tuberculosis. With a history of a stormy period from the above disturbances in early life, and also a family predisposition to tuberculosis, one has to regard the danger to the child of tuberculous peritonitis as a real one. So far as the preventive treatment of tuberculous peritonitis is concerned, we shall probably do more by the regulation of the diet, so as to avoid gastro-intestinal disturbance, than by the attempt to destroy tubercle bacilli in the milk. If the mucous membrane of the stomach and bowel is in a healthy condition, it will be able to protect itself from the invasion and penetration of any tubercle bacilli.

In all acute cases, and in all cases with pyrexia, rest in bed should be maintained for a time. The natural tendency is to put such cases on a " sloppy " diet—milk, bread and milk, and pudding. Experience has shown that this is the worst possible form of treatment. The abdominal swelling which is present is largely due to the intestinal catarrh or ulceration, with consequent flatulent distension and atony of the bowel. These conditions are increased on a diet of farinaceous foods and milk, which ferment in the bowel. The first part of the treatment is to clear out the bowel thoroughly, and the next to put the patient on a non-fermentable diet. A drachm of castor oil may be given twice daily until four doses have been taken, or some other simple evacuant may be used. The diet selected should be one which will allay intestinal catarrh, which will not decompose readily in the bowel, which will be easily digested and absorbed, and which will supply the system with the important constituents calculated to combat the affection. These conditions are best fulfilled by a protein diet. At the outset, if pyrexia and loss of appetite are present one can order a diet of mutton, beef, veal, or chicken soup. Small quantities of these should be given at frequent intervals during the day. For children, these soups should never be made strong, as concentrated soups are apt to produce indigestion. They may, however, be made more nourishing by the addition of raw meat juice, 1–2 oz. daily in divided doses, or plasmon powder, or somatose. It is to be noted that diarrhœa is no contra-indication to this diet. Diarrhœa in these cases is usually due either to the fermentation of food or to the presence of ulceration in the bowel, and the protein diet will be found suitable in both conditions. The important point is to give only small quantities of food at first. As soon as possible, that is to say, when the patient will take it, more solid food is to be ordered in the form of pounded fish or chicken, or mutton, with some breadcrumb and white of egg to make it more savoury and appetizing. This is to be given quite irrespective of the condition of the temperature chart, provided the patient's appetite is good. In some cases one will find that during the morning apyrexial stage the patient is ready for solid food, while during the evening pyrexia he is feeling ill and is disinclined for anything but fluids. Advantage should be taken of the fluctuations of the temperature chart to feed accordingly. Often one will find that although pyrexia continues, the patient's tongue is clean and the appetite is rapidly improving. Advantage is taken of this to put him on to a meat diet, which he can chew thoroughly. It must be recognized that in children over three years of age a diet of plainly cooked food is more digestible and more nourishing than any forms of invalid cookery. The following dietary therefore may be ordered as suitable both for the later stages of an acute case, and for those chronic cases in which the temperature has never risen above 100° F.

Breakfast.—Fresh fish; tongue, freshly boiled or tinned; white of egg, raw or lightly boiled; two small pieces of crisp toast; one teacup of weak cocoa, with 1 oz. of milk.

Dinner and Supper.—Fish, chicken, sweetbread, tripe, hot or cold boiled or roast mutton or beef; chops and steaks. These must be plainly cooked, and served without any fat and without any sauce or gravy. A small quantity of breakfast or dinner biscuits (one tablespoonful), or two plasmon biscuits. Half a glass of claret.

If the appetite is good, as it usually is, three meals a day are better than frequent small meals. If, on the other hand, the patient is not inclined for a good meal, then the same materials should be given more frequently in smaller quantity. Raw meat sandwiches, made of scraped beefsteak and thin slices of stale bread, are usually readily taken by children, and may be given between meals. The amount of carbohydrate material is to be strictly limited, but a small quantity is probably not injurious and is much appreciated. Only a small amount of fluid is to be allowed at meals, as a dry diet is more digestible, but water may be given freely between meals. Claret acts as a tonic, and as an astringent when diarrhœa is present.

The benefit derived from one or other form of this protein diet is usually striking. The patients take it with relish and without discomfort. The abdominal distension usually subsides markedly within a week or ten days. The motions become more healthy in character, and if diarrhœa has been present it usually passes off. If there is no improvement under this treatment, one is led to suspect that there may be some grave lesion present, such as extensive ulceration of the bowel, or a mass of caseous and suppurating glands, or a rupture of some intestinal ulcer, with leakage and abscess formation in the surrounding tissues. It is plain one cannot expect improvement from dietetic treatment under such conditions.

The above diet, while it is strengthening and tends to maintain the vital powers of the patient, is not fattening. As soon as possible, one goes on to add some fatty food in the form of cream or cod-liver oil to increase the nutrition. This is a much more severe test of the digestive powers, and the fatty food must be commenced tentatively and in small quantities at first. I have frequently found digestive disturbances follow at once, so that one had to fall back on the protein diet. One drachm of cream or the same amount of cod-liver oil and malt may be ordered three times a day. Some children will take by preference a sardine with some of the accompanying oil, and this, or the yolk of an egg, may be substituted. The amount may be gradually increased, and some beef or mutton fat may also be allowed as the convalescent stage is reached. At this period also one may allow a return to milk and farinaceous foods, care being taken that the quantity given is small at first.

I do not say that a protein diet is a cure for tuberculous peritonitis, but I believe that it places the patient in a better position to resist and conquer the attack of the tubercle bacilli. As fresh air tends to check pulmonary catarrh, and thus allows of pure air entering the pulmonary blood vessels, so a protein diet tends to check intestinal catarrh and allows the pure products of digestion to enter the blood stream. These are all the advantages that are claimed for it, but if the disease is not too advanced the result is usually satisfactory.

CONGENITAL PYLORIC STENOSIS

This is an affection of early infancy to which attention has only recently been directed. Cases are still being frequently overlooked, the proper treatment is not carried out, and the infants die. As the disease is not fully described in many text-books, we shall refer first of all to the clinical symptoms, which are as a rule clearly defined, and allow of an early diagnosis being made if the possibility of pyloric stenosis be kept in mind.

The history is usually as follows: An infant, healthy at birth, seems to progress satisfactorily for two, three, or five weeks, and then vomiting comes on. It does not matter what the food is, breast or artificial feeding, the vomiting persists. Frequently it is suggested in such a case to try another food, and the baby is started on a career of different diets. A most misleading occurrence in this connexion is that a change of diet has often a temporary effect in checking the vomiting. It may be only for a day or a week, but the cessation of vomiting suggests that the disturbance is due to the food, that the appropriate food has not been found, and so the hunt continues. The result is usually the same—failure of the treatment and death of the child. The vomiting is really a regurgitation of the food, without any of the signs of nausea, gastric catarrh, or acute disease. At the beginning it is moderate in amount, not specially violent, and only occasional. As time goes on—and time is measured by days in this affection—the amount of vomited material becomes larger, representing two or three feeds, and the violence of the vomiting is much greater, the food being shot out through the mouth and nose for some distance. The vomited matter consists only of the food, partly digested. Occasionally blood is present, but never bile. The amount vomited may be considerably greater than a normal stomach could contain at this age, showing that dilatation has taken place. The frequency of the vomiting varies, sometimes occurring only once a day, and at other times more frequently. The act of vomiting does not distress the patient, in fact it often brings relief, and the child is at once ready for another feed. It is almost characteristic of these cases that the infants are always ready for a feed, being in a chronic state of hunger. The infant wastes rather rapidly at first, and then more slowly, but steadily. A careful physical examination will usually reveal either marked peristaltic contraction of the stomach, or an enlarged and hardened pylorus, or both.

All are agreed as to the clinical symptoms, but a good deal of difference of opinion exists as to the pathology. A hypertrophic condition of the muscular tissues of the pylorus is always found at operations or on post-mortem examination in typical cases, although occasionally in practice one meets with atypical cases in which probably spasm is present without hypertrophy. The latter are much more amenable to medical treatment. The hypertrophy is believed by some to be due to a congenital hyperplasia of the pyloric muscle (Cautley), and by others to be the result of persistent spasm. From the therapeutic point of view it is important to note that the pyloric spasm is the chief factor, as owing to the spasm the food is unable to pass the pylorus. A condition of hyperplasia or hypertrophy should not, and probably does not, of itself prevent the pylorus from relaxing, but it may tend to render spasm more easily induced, and more persistent than under normal conditions. There is clinical evidence in favour of the view that such spasm is caused by the irritation of food in the stomach. However carefully an infant may be fed, some gastric disturbance or indigestion must happen at times, and this may be the starting point of a pyloric spasm which tends to persist. Hence we find that although the lesion is probably congenital, the symptoms may not appear for two, three, or even six weeks. The sequence of events would appear to be, first gastric irritation, secondly pyloric spasm, and thirdly hypertrophy and dilatation of the stomach from its efforts to drive the food through the pylorus. The vomiting is induced by the irritation of the stagnant gastric contents, and sometimes by the large quantity of food which accumulates in the stomach.

The **important medical measures** are, first, suitable feeding, and secondly, washing out the stomach (lavage). The food requires to be such that it can be completely digested in the stomach, so as to leave no solid residue to induce pyloric spasm.

The difficulty therefore lies in the casein and the fat of milk. No food is better than breast milk, provided it is of normal quality and contains no excess of fat. This should be determined by chemical examination, and if necessary the mother's diet can be altered so as to bring her milk to the proper standard. In any case the breast milk should not be discarded until a strong effort has been made to use it successfully. Fresh cows' milk as commonly used in infancy is not as a rule well tolerated in this affection, at least for some time, and one has usually to commence with some substitute in which the casein is more digestible and the amount of fat is kept small. Peptogenized milk or whey may be used. In such cases also life can be maintained by the use of certain foods which are of themselves incomplete, but which are capable of being digested in the stomach, such as Allenbury's food (No. I), Mellin's food, or malted milk. Whatever the diet is, the food must be given well diluted at first, and gradually increased in strength as toleration is established. A method which will be found useful is to alternate weak whey or peptogenized milk with one of the foods mentioned above. Sugar in the form of malt extract may be given in excess of the normal requirements, as it is very digestible. A little orange or grape juice may be given in water. A few drops of raw meat juice may be added to each feed or alternate feed.

To ensure complete digestion in the stomach the quantity given at a time must be small, and the frequency of the meals must be increased. From 2–3 oz. is usually as much as should be given at a time, and less may be called for if vomiting persists. The feeding will often require to be carried out every two hours during the day and night, and sometimes one will obtain better results by feeding every hour during the day. Both the quantity and the frequency of the feeds must be regulated according to the results of experience in individual cases. One must not expect that the fattening up process will go on rapidly. Every attempt to increase the fatty element in the diet is often followed by gastric disturbance and increased pyloric spasm. The administration of cod-liver oil by inunction, if it be of any value, would appear to be specially suited to the conditions present, owing to the difficulty of getting fat into the system by the natural channel. Rectal feeding in the case of young infants cannot be carried out with any success. In many cases the tissues are dried up from the loss of fluid, and the use of saline injections, both subcutaneously and per rectum, is beneficial. From 4–10 oz. of normal saline solution may be injected subcutaneously every day, and will act as a restorative until the improvement of the pyloric function allows of the entrance of a sufficient amount of fluid by the natural route. In cases in which the infant is much reduced or has a subnormal temperature, brandy, up to a drachm daily, will be found of service as a general tonic.

Gastric lavage is useful in two ways, first in removing all irritating remnants of food from the stomach, and secondly in showing the physician how to regulate successfully the food and feeding. For the latter reason it must be carried out under the supervision of the physician, and not left to a nurse. The stomach should be washed out once a day for a prolonged period, and in bad cases this proceeding may be required twice daily for a time. It should be done when under normal conditions the stomach is empty, i.e. two or two and a half hours after a meal as the case may be. The wash-out should show a small amount of soft, flocculent matter, which tends to get less in successful cases as time goes on. If, on the other hand, a large amount of matter is washed out, or undigested curds, it is clear that the food is not being properly digested, and will maintain the pyloric spasm. The food materials must be changed, or at any rate that food which is not properly digested, and it may be that the quantity of food and frequency of feeding will have to be altered. Dr. Cautley has pointed out that in many cases the mere washing out of the stomach systematically will check the vomiting, and that this may prove misleading. This is true, and enforces the importance of examining carefully the nature of the stomach contents in order to judge whether they are likely to pass the pylorus. If the residue is of the soft flocculent nature described above, one may reasonably expect that it can and will prove non-irritating, and will eventually pass through the pylorus.

The **signs of successful feeding** in these cases are as follows The vomiting ceases. The bowels come to act naturally. This is in marked contrast to what happens in untreated cases, where marked constipation is the rule, artificial aids per rectum being very often required, and the motions contain little fæcal matter. The stomach peristalsis becomes less marked, and gradually passes off. This is due to the absence of irritating food material which the stomach had previously been trying to drive through the pylorus. The discomfort, pain, apathy, and constant whining of the infant cease. This is owing to the appetite being satisfied by the entrance of food into the system. The nutrition of the infant is improved, as shown by the healthier colour, the increased activity of the limbs, and a slow gain in weight. It is very important to remember that these infants cannot be fattened rapidly, that any attempt to secure this will probably end in disaster, and that the less weighing there is the better, especially if there are anxious relatives about. The most suitable foods are not fattening ones, and any excess of food is apt to produce disturbance in the stomach and bowel. On the other hand, the vital powers of the infant can be very much improved, and the disordered functions restored to healthy action, by a simple diet, and the fattening materials can be reserved to a later period. The increase in weight of the infant is somewhat fluctuating at first, and tends to become steady as time goes on, but is always slow.

A common **complication** in the course of treatment is diarrhœa. In cases of pyloric stenosis the bowel has been out of use for some time, and is consequently unprepared for the food material which now passes through the pylorus. Hence arises what is probably a form of irritative diarrhœa, which is always serious and may prove fatal. In such cases it is advisable to reduce the amount of food by one-half, and to give sips of hot water frequently. After an attack of vomiting no food should be given for at least two hours, so as to rest the stomach. Intestinal flatulence is to be treated, like diarrhœa, by a temporary reduction in the amount of food.

We have entered rather fully into this somewhat rare condition of pyloric stenosis, but believe that the importance of the dietetic treatment fully justifies it. Until recently operation was regarded as the only possible method of cure; but within the last two years many cases have been cured by means of dieting and lavage. At the same time it may be stated that no disease will tax the practitioner's powers and resources in the matter of dieting more than congenital pyloric stenosis.

RICKETS

The exact ætiology of rickets is still unsettled, but certain factors in its production have been determined. We are not concerned here with all the causes, but there is a consensus of opinion as to the importance of the diet. As Dr. Cheadle well expresses it; "The only constant factor, always present, is the food factor. Sometimes it is the only factor. The chief cause, this fault of diet, is the commonest, the most potent, and dominant of all." An amount of clinical evidence has now been collected on this subject which is perfectly conclusive. The well-known experiments of Mr. Bland Sutton at the Zoo showed that the lower animals might suffer from rickets from exactly the same causes as infants. Artificial feeding for the young lion whelps had to be employed owing to the failure of their mother's milk supply. They were fed solely on the flesh of old horses, almost entirely destitute of fat, with some goats' flesh occasionally. On this they became extremely rickety and one died. Mr. Bland Sutton then continued the meat diet, but added to it milk, cod-liver oil, and pounded bones. The change which followed was remarkable, for in three months the animals had lost all signs of rickets, and they grew up perfectly healthy. In the present day one does not usually find that it is the quantity of food which is at fault in cases of rickets, but the quality. There will be found in the previous diet an absence of certain food materials and an excessive amount of others. Expressed otherwise, there is an **error of defect** as regards the **fatty elements**—a constant factor; and an **error of excess** as regards the **carbo-hydrate elements**—a variable factor. Further analysis shows that the primary factor in the production of the pure clinical picture of rickets is a deficient amount of fat in the diet. If in addition the protein element is defective, there will be added weakness and impairment of nutrition. If in addition the carbo-hydrate element is in excess, there is apt to be gastro-intestinal disorder, followed by toxæmia from the absorption of improperly digested food or the products of the decomposition of the food.

The development of rickets takes place slowly as the result of the prolonged use of an improper diet. The beginnings of the disease are not readily recognized by the public. In certain classes of society rickets is so common that its leading features have come almost to be regarded as physiological in infants, and some rachitic babies are viewed as types of health and beauty. The disease frequently arises from the prolonged use of a food or a diet which had been ordered for some passing disorder. The food factors in the production of rickets will vary in different countries just as the feeding of infants does, but the general principles given above will hold good everywhere. In connexion with the subject of diet we shall have to consider both the preventive and the curative treatment.

The preventive treatment.—The special preventive treatment of rickets lies in the adoption of and persistence in a proper diet. This has already been fully discussed in connexion with the feeding of infants. Custom, cheapness, advertisements, etc., have brought into common use many articles of food which are not suitable for infants, and which induce rickets when exclusively used.

The various forms of **condensed milk,** when diluted for use, are notoriously **deficient in fat,** and many of them contain an excess of sugar. This deficiency of cream is present in the best condensed milk, which is made from the whole milk, and is therefore much more marked in that made from separated or skimmed milk. There are other defects in connexion with condensed milk, which render it unsuitable as a complete food for infants, but only its influence in inducing rickets need be considered here. The chemical analysis which is often attached to the various brands of condensed milk is misleading, because it shows the composition of the milk when condensed, and not its composition when diluted for an infant's use. Huchison quotes from Pearmain and Moore the following analysis of some of the best brands of condensed milk when diluted as recommended for the use of infants.

	Dilution recommended for Infants' use.	Fat in such product.
A	1 to 5	1·8 per cent.
B	1 ,, 14	0·7 ,,
C	1 ,, 14	0·6 ,,
D	1 ,, 15	0·7 ,,
E	1 ,, 14	0·8 ,,
F	1 ,, 14	0·7 ,,
G	1 ,, 14	0·7 ,,
Human milk . . .	—	3·5 ,,

Both clinical experience and chemical analysis show that condensed milk from its deficiency in fat should not be used as the diet for an infant if rickets is to be prevented. Another factor in the production of rickets is the excessive amount of sugar which is present in many condensed milks. This makes a baby fat but not healthy, and is frequently the cause of gastro-intestinal indigestion. In all cases in which indigestion is present any tendency to rickets which arises from the nature of the diet will be much increased. Rickets will also be developed on other forms of milk in which the fatty element is deficient, such as separated milk, skimmed milk, and buttermilk. These also stand condemned as a complete diet for infants.

The **tinned starchy foods,** whether converted or unconverted, are largely responsible for the **production of rickets.** They are characterized by a deficiency in fat and protein, and by an excess of carbo-hydrate material. In those in which the starch is unconverted there is the additional drawback that gastro-intestinal disturbance will probably be induced at an early stage, and the nutritive value of the food will be still further diminished. These "infants' foods" make fat, flabby children, but the fat is of an unhealthy character, and is quite different from the product of a diet rich in animal fat. The physiological needs of infants would be better met by a diminution in the use of "infants' foods," which might be prohibited entirely without any loss to the infantile population. If their use for infants under twelve months of age were allowed only under medical advice there would probably be a great fall in the infantile mortality from rickets in large cities. Other starchy foods, not of a proprietary nature, such as ground barley, arrowroot, and cornflour are equally effective in the production of rickets, but they have rather fallen into disuse in the present day, having been replaced by the "infants' foods."

It is sometimes stated as regards these foods, condensed milk and starchy preparations, that if deficiency of fat is the source of trouble, this can easily be remedied by adding some cream or butter. This, however, is not sufficient, and there are other drawbacks to such a system. One must recognize the tendencies of the female mind, and one of these is to regard any advertised food as possessing special virtues. The average mother has much more belief in a food that comes out of a tin, with a label extolling its good qualities, than in ordinary dairy milk. She will naturally concentrate her attention on what she believes to be the important article of diet, and will tend to neglect the precautionary additions, of the value of which she knows nothing. Many of the proprietary foods are sold with instructions appended as to the addition of fresh cows' milk. One finds, however, as a matter of experience that as time goes on the amount of fresh milk is not increased, and is possibly lessened, while the amount of the patent food is steadily increased. In the preventive treatment of rickets it is not sufficient to give from a quarter to half a pint of cows' milk daily, along with some other food, but there must be a proper amount of fresh proteins and fats. Again, one constantly meets with cases in which some months previously a medical man had ordered condensed milk or some patent food for a temporary digestive disturbance, and this food had been continued until the symptoms of rickets led the mother to seek medical advice again. It is of the greatest importance that a time limit should always be imposed in the case of such substitute feeding, lest its undue prolongation lead to the production of rickets.

The question is sometimes raised—and it is a very important one—as to whether an infant, nourished entirely at the breast, ever develops rickets. The answer must be in the affirmative, but with qualifications. If a healthy mother, with plenty of good milk, feeds her infant at regular intervals and uses no other food whatever, we may safely assert that the infant will not become rickety during the normal period of lactation. The cases of rickets in breast-fed infants in the writer's experience have occurred as follows: In some cases there has been too frequent feeding, which resulted in the production of a milk deficient in fat, and as regards the infant in gastro-intestinal catarrh. The milk being deficient in fat and the digestion being imperfect, the conditions for the development of rickets were present. In other cases an excessive amount of unconverted starch, either in the form of thick barley-water, or of some proprietary food, was given to the infant in addition to the breast milk. The disturbance of digestion which accompanies the use of improper food may render the assimilation of the best milk impossible. Again, lactation may have been carried on beyond the normal period, and the nutriment supplied has become deficient in fat. In some cases, from too frequent child-bearing, the breast milk after two or three months may be of such inferior quality that rickets develops. Dr. Cheadle has found that if a mother becomes pregnant while suckling, the fœtus in utero may flourish, but the infant at the breast may dwindle into a condition of rickets and marasmus. This he ascribes to the diversion of the nourishment from the breast to the fœtus. These exceptions in no way affect the general rule that sound breast milk is the best food for infants.

In the case of infants over a year old, the same general causes, namely, a deficient amount of fat and an excessive amount of carbo-hydrate, must be avoided in the preventive treatment of rickets. Carbo-hydrates are cheap and easily prepared, while fatty foods are dear and are not in such common use. Tea, bread, jam, potatoes, and perhaps a "penn'orth of milk" represent a common dietary for young children, and it is one specially conducive to rickets. Such a diet is so deficient in fats and proteins that its unsuitableness is at once apparent. These deficiencies must therefore be avoided.

The curative treatment.—In an ordinary case of rickets there are two stages in the curative treatment, first to relieve the gastro-intestinal disturbance by a spare diet of weak and digestible food, and secondly to cure the constitutional affection by a dietary in which fats and proteins are fully represented.

It is useless to commence with a large amount of fatty food because the already impaired digestion would only be still further weakened. There are usually present intestinal catarrh, a dilated and weakened condition of the wall of the stomach and bowel, and fermentation of the intestinal contents. It is advisable, therefore, to begin with simple plain food in small quantities. An infant of twelve months may be ordered a mixture of milk, lime-water, and thin barley-water in equal proportions, of which 4½ ounces may be taken every three hours during the day. After some days of this dietary, it may be less than a week, or more, according to the conditions present, the strength of the food may be increased by giving equal parts of milk and lime-water. If, on the other hand, the signs of gastro-intestinal fermentation persist, it is advisable to stop all milk for a few days, and to give only weak mutton or chicken soup. This, along with suitable medication directed to the bowel condition, will soon allow of a return to milk. The quantity and strength of the milk mixture are to be gradually increased until the patient is taking a pint of milk and half a pint of barley-water daily.

In the second stage of the treatment a fuller dietary is called for so as to procure proper nutrition and remove the rachitic debility. The fatty element comes first in importance. Fat may be given in the form of cream, butter, dripping, yolk of egg, beef, mutton, or bacon fat, or cod-liver oil, the chief essential being that it is animal fat. Vegetable or mineral oils do not seem to be nearly so efficacious. It may appear at first sight superfluous to give a large fat baby more fat in its diet, but experience has shown that the fatty tissues of a rickety infant, derived as a rule from carbo-hydrates, are merely a burden. Under the use of a diet rich in animal fat these flabby tissues melt away and are replaced by healthy tissues. Further, there is required for the growth and nutrition of most of the organs an abundant supply of fat, and in rachitic babies these organs may be said to be starved in this respect. As a result their function is much impaired and their powers of resistance much lowered. Hence we find that many of the disorders of rachitic infants do not yield readily to an ordinary diet, nor to ordinary medication, but do yield to a full amount of fat in the food. In the employment of fat, therefore, in the treatment of rickets, in order to procure the full effect as speedily as possible, we must not be content with a normal amount of fat, but should push it to the full degree of toleration, as judged by the digestive powers, and the nature of the stools. The form in which the fat is administered is not unimportant, and gravity cream, bacon fat, and cod-liver oil will be found the most suitable for young children. Fresh milk, containing as it does a fine emulsion of fat and a large amount of protein, is to be regarded as the chief article of diet during the whole of the rachitic period. It is of the first importance that it should be whole milk, and uncontaminated by preservatives or sterilized by excessive heating. To a slight extent by boiling and to a marked extent by sterilizing, the fat of milk is altered as regards its digestibility. Probably unboiled milk is more rapidly efficacious in rickets than boiled, and the former should be used whenever the purity of the milk can be relied on. If additional protein food seems called for, it may be given in the form of white of egg or raw meat juice, half to one ounce to be added to the milk daily. The raw meat juice is especially useful when the anæmia of rickets is pronounced. The supply of carbo-hydrate material may be temporarily diminished during the active stage of treatment. Just as the tissues have been described as being starved of animal fat, so they may be said to have been saturated with carbo-hydrates. The history of the previous diet will usually show that clearly. Both the digestion and the system generally will benefit from a strictly limited amount of sugar, bread, and puddings. Hutchison, speaking of the dietetic treatment of rickets, says that "a rickety child must be mainly carnivorous, as rickets might be said to be due to premature vegetarianism." Rickety infants have often a great liking for salt, and this probably implies a demand on the part of the organism. One to two drachms of common salt may be given daily in the milk. It will also be found beneficial to give some fresh fruit, such as orange or grape juice, and a small quantity of mashed potato occasionally. These will supply the anti-scorbutic elements, which have often been markedly deficient in the previous diet. This addition is specially called for in all cases where tenderness of the limbs is present.

A dietary suitable for different ages may be drawn up as follows :—

Between nine and twelve months.—Cows' milk which has been brought to the boil, and slightly sweetened and salted (1–1½ pints daily).

Half a teaspoonful of butter, or two to three teaspoonfuls of cream may be given three to four times a day in the milk. Cod-liver oil.

Two meals in the day may consist of (1) porridge made with milk, or (2) any plain milk pudding, or (3) boiled bread and milk.

The child should be fed every three hours by day and only once during the night (10 p.m. to 7 a.m.).

Between twelve and eighteen months.—The milk may be increased to two pints a day. In addition there may be given an ounce of cream, or the yolk of one egg, or bacon fat, daily. Bread and butter are allowed, the former in strictly moderate amount. Cod-liver oil.

After eighteen months.—In addition to the above, boiled fish, chicken, mutton, biscuits, and green vegetables are allowed. The quantity of milk must be lessened when other foods are added, but the fatty material must be in sufficient amount. Cod-liver oil.

Cod-liver oil holds a prominent place in the dietetic treatment of rickets from its being one of the most convenient forms of giving fat. In one or other form it is usually taken readily by the youngest rachitic subjects, and is easily digested. While it is really to be regarded as a food, it appeals also to the lay mind from the fact that it is sold in medicine bottles. The variety of preparations on the market show that all differences in taste have been consulted. The oil may be given either in the crude form, or in the refined preparation which is commonly sold. As a rule, a good emulsion is to be preferred, as being more palatable, and therefore probably more digestible. The following is the preparation in use at the Children's Hospital, Paddington Green.

EMULSIO MORRHUÆ ET HYPOPHOSPHITUM.

℞.

Sodii Hypoph., Calcii Hypoph.	āā gr $\frac{1}{2}$
Olei Morrhuæ	♏xxx
Olei Cassiæ	♏$\frac{1}{10}$
Glycerini	♏vi
Tragacanthæ	q.s.
Aquam destill. ad	ʒj

This emulsion contains 50 per cent of cod-liver oil, and the dose is from 1–2 drachms three times a day. The great advantage about cod-liver oil as a fat is that it can be obtained of reliable quality at a moderate price. **Yolk of egg** is also an admirable fatty substance, but eggs are frequently expensive and of doubtful freshness. It is not advisable to give a rickety baby the yolks of "cooking eggs" or of eggs which have been preserved for six months. When the freshness of the egg is beyond suspicion, there is no better fatty food for the youngest rickety infant. The yolk may be given raw and mixed in the milk, or may be lightly boiled.

SCURVY

It is found that over 75 per cent of the cases of scurvy occurring during the whole period of childhood arise between the sixth and twenty-fourth months, and hence the term "infantile scurvy" is fully justified. Scurvy is essentially a disease of diet, as a faulty diet will invariably be found to be the primary cause. Dr. Cheadle, who was the first to recognize the condition of infantile scurvy in this country, says: "In no instance have I seen the disease arise in an infant at the breast, or when fed on an ample supply of good cows' milk. Oatmeal and water, bread and water, various patent farinaceous and desiccated foods, peptonized milk, condensed milk, sterilized milk, 'humanized' milk, German sausage, bread and butter and tea, beef-tea, gravy and bread, in most cases with no fresh milk at all, in a few with a very small amount only, are the dietaries on which I have seen scurvy develop, and, latterly, most often on the peptonized and pancreatized foods now so much in vogue."

The following facts in connexion with the ætiology of scurvy may be borne in mind: (1) Scurvy is a disease of defect, not of excess. (2) The defect consists in the absence from the diet for a prolonged period of a sufficient amount of the anti-scorbutic element in food. (3) Although the exact element is not known, the foods which contain it are known. (4) The anti-scorbutic element is found most abundantly in fresh or living food, more especially in fruits and vegetables, and the further we get from fresh food as the regular diet, the greater is the tendency to scurvy. (5) There is a class of prepared foods for infants (tinned foods, "proprietary foods," "infants' foods") in which, during the process of preparation, the anti-scorbutic element has been entirely destroyed.

The **preventive treatment of scurvy** may be briefly summed up as the employment of a fresh food diet, suitable in quantity and quality to the age of the child. This has already been described. If cows' milk is the diet, the milk must be fresh, of sufficient quantity, and not altered by prolonged boiling or pasteurizing. Many cases of scurvy have been traced to the use of sterilized or pasteurized milk. This risk has been increased recently by the action of several of the large dairy companies, which are supplying pasteurized milk to all their customers, without any intimation that the milk has been so treated. As many of the customers proceed to boil the milk on delivery, the vital element in it will be in an extremely attenuated condition by the time the milk reaches the infant. The custom referred to is a recent one, but Dr. Coutts has already recorded a case of an infant suffering from scurvy who failed to improve on the dairy milk supplied. It was then discovered that this milk had been pasteurized, and on changing to fresh cows' milk, rapid improvement took place. Cases have also been traced to the use of milk from municipal dépôts, where undoubtedly the milk had been treated in an injurious way by prolonged heating. While the risk of scurvy is increased by prolonged pasteurizing or sterilizing, the domestic method of boiling the milk for a few minutes, or scalding it, is probably harmless. Sometimes over-dilution of the milk leads to scurvy. It is said that a quart of milk contains as much citric acid as an orange, and this citric acid is looked on by many as the anti-scorbutic element. But if an infant receives only one quarter or one half of a pint of milk daily, the amount of anti-scorbutic material may be so small that scurvy develops. It is therefore necessary to see that there is a sufficient quantity of fresh milk in the dietary, namely, 1 to 2 pints daily. Another curious fact about scurvy is that it often develops as the result of the prolonged use of some special food ordered for the cure of another disease or disorder. Thus, owing to indigestion of some form, an infant may have been put on peptonized milk, and after some months of this diet scurvy is produced ; or condensed milk has been prescribed for gastro-intestinal disturbance, and after some months scurvy appears. It must be remembered that predigested milk and condensed milk are liable to induce scurvy if employed as the sole diet for any length of time.

The direct connexion between the employment of a diet consisting of condensed milk and other patent "infants' foods," and the subsequent appearance of scurvy, has led all writers on the subject to regard such a diet as the chief cause of scurvy. Some of these foods are more frequently associated with scurvy than others, but this pre-eminence is due (1) to the larger sale of the food, or (2) to its use during the earliest months of life, or (3) to its exclusive use without the addition of any fresh milk. It is daily becoming clearer that these artificially prepared and preserved foods are not to be depended on in the feeding of infants, and in the preventive treatment of scurvy they must be abolished entirely from the diet, as it is practically impossible to confine their use within safe limits. After the age of two years scurvy becomes much less common because fruit and vegetables almost invariably form part of the diet. In rare cases one finds that there is a positive dislike to fruit and vegetables in any form, and in the absence of any anti-scorbutic material in the diet, scurvy may appear. In such cases the special dislike must be overcome by firm treatment.

The **curative treatment** proceeds on the same lines as the preventive. In the case of infants, fresh milk is to be given, and in order to secure the most prompt effect, it should not be treated by heat in any way. There is little doubt that unboiled milk is a more efficient anti-scorbutic than boiled, and whenever the purity can be relied on milk should be given unboiled. At the same time the anti-scorbutic element in cows' milk is small, although sufficient to ward off scurvy, and in the curative treatment larger amounts of the anti-scorbutic element are called for. Raw meat juice has been recommended by Dr. Cheadle and Sir Thomas Barlow for the anæmia which is usually present. It is not of great anti-scorbutic value, as hung meat only is used in this country, but is easily retained and digested. For an infant of twelve months, half an ounce of expressed meat juice may be given daily, in divided amounts and well diluted with milk or water.

The more special part of the dietetic treatment consists in the free administration of fresh fruits and vegetables, whose anti-scorbutic value is great. The full list of these is a large one, but the following will be found the most useful, namely—oranges, lemons, grapes, potatoes and cabbages. In the case of infants under one year, the juice of oranges or grapes may be expressed, and half an ounce may be given in water three times a day. For older infants, boiled and sieved potato, mixed with milk, is a most effective anti-scorbutic. Dr. Hutchison recommends that the potato should be boiled in its skin, and that the floury part just beneath the skin should be used, as this is richest in potash salts. Another plan, suited to those with weak digestive powers, is to administer the vegetable juices through the medium of beef-tea or chicken-tea, in which potatoes and carrots have been boiled and strained off (Cheadle).

Care must be taken that the amount of fruit or vegetables is not in excess of the infant's digestive powers, in which case sickness, flatulence, diarrhœa, etc., may follow and interfere with the recovery.

The effect of this special treatment is one of the most striking in medical therapeutics. Improvement is often noted within a couple of days, and recovery from acute manifestations within a week, provided that the disease has not progressed too far. The child begins to brighten, milk is taken with avidity and relish, the hæmorrhages cease, the swelling of the gums subsides, the tenderness in the limbs becomes less marked, and there is not that look of anxiety, from fear of movement, on the approach of an attendant.

We have pointed out in connexion with rickets that scorbutic symptoms may be associated with that disease. So it will often be found that scurvy is complicated by rickets. In other words, a double defect, absence of fat and of the anti-scorbutic element, is often present in the dietary at the same time and leads to the production of the two diseases. This fact must be borne in mind in connexion with the treatment, for a rachitic infant will not recover so rapidly if the scorbutic element is overlooked, and vice versâ.

It has been held by some that if only the anti-scorbutic element is wanting in the diet, the same food may be continued in cases of scurvy with the addition of some orange juice. This is false reasoning, and a complete change of diet is almost invariably called for. In some rare cases it may be only over-dilution of the milk and starvation which has produced the disease. Dr. Colman has specially emphasized the fact that rapid improvement is not to be looked for in scurvy unless all preserved foods are omitted from the diet. He has seen three cases in which, although fresh milk, raw beef juice, and orange juice were freely administered, the pains did not subside until the patent food, which had been persisted with, was stopped. As soon as this was done, the subsidence of all scorbutic symptoms was immediate. An explanation of this failure of the treatment while the previous diet was continued may be found in the toxic theory of scurvy. According to this view there is not only an absence of fresh food material but there are toxic properties in the food used. Nansen found that scurvy did not arise in his Arctic expedition as long as the tinned provisions were wholesome, but the preservation was imperfect and scurvy broke out. Now tinned foods are largely associated with the occurrence of infantile scurvy, and although the food may be sound when the tin is opened, it is very liable to decompose after being exposed to the air. The contents of a tin have usually to last for some days, and it may be that during this time contamination and decomposition take place. For these reasons our aim should be to employ not the minimum amount of change in the diet which may bring about a cure, but to secure the maximum of benefit in the shortest time by a radical change of diet.

DIET IN THE DISEASES OF HOT CLIMATES

CHAPTER XXVIII

DIET IN THE DISEASES OF HOT CLIMATES

By Sir Patrick Manson, K.C.M.G., M.D., F.R.S., and
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General considerations.—Some tropical diseases, such as sprue and dysentery, are in the main best treated by modifications in diet, whilst in other tropical diseases diet is of subsidiary importance, and in others again errors in diet are causes of relapse or of grave complications.

In tropical countries the normal diets of the European and native inhabitants respectively differ more than do those of the various classes of the inhabitants of temperate climates. The effects of dietetic errors in Europeans in the tropics are, on the whole, more marked than would be the case from similar errors in temperate climates; this is specially so as regards the abuse of alcohol and condiments, and also as regards deficiency of fresh vegetables, of fruits, and occasionally of meat.

Frequently the European in the tropics does not modify his diet sufficiently, and does not make adequate use of the local vegetables and other native material. The meats and fruits there are sometimes comparatively dry and tasteless, and the vegetables are apt to be indigestible and of inferior quality. More thorough cooking and also higher spicing of the dishes are frequently resorted to and a larger variety of methods of preparation employed. As a result the bulk of food taken is as much or even more than in Europe, and protein material, not always in a very digestible condition, forms too large a proportion of the dietary.

Moreover, as less active physical work is usually performed, and as the heat production required to maintain the body temperature is less, the result is that an excess of food material is ingested which has to be excreted or more or less injuriously assimilated. The excretory organs are thus unnecessarily taxed and owing to the usual free diaphoresis the fluids taken are insufficient to flush the kidneys properly, or to secure adequate excretion of the solid products by that channel. The liver may become abnormally congested and in many cases nervous symptoms, similar to those attributed to uric acid poisoning, may develop. In other cases the digestive organs fail and chronic atonic dyspepsia, dilated stomach, chronic constipation, or less commonly chronic diarrhœa, sometimes of a lienteric character, are the consequences. Copious draughts of water, of aerated waters, and iced drinks are also a fruitful source of dilatation of the stomach and of gastric catarrh.

Another potent cause of tropical dyspepsia is the use and abuse of drugs, such as quinine. As a prophylactic this drug is still necessary in the more malarial districts where other preventive measures have not been instituted or are ineffective. Its persistent employment in this way may lead to a form of atonic dyspepsia, or of gastric catarrh.

Many of the conditions known popularly as "tropical liver" are due to dyspepsia produced in one or more of these ways, possibly in some instances complicated by alcoholism.

Many tropical diseases, such as repeated attacks of malaria, bring about mental depression and indifference to food. Under such conditions food may be taken irregularly and in insufficient quantities, and little attention may be paid to the quality or the cooking. These circumstances may lead to alcoholism, as the sinking feeling so commonly felt is temporarily relieved by stimulants.

Some of the effects of these various conditions are slight in young and healthy adults. In others, even in those who live an open-air life, and who take plenty of active exercise, although they may not be seen at first, they may manifest themselves after several years of apparent immunity. In persons living a sedentary life, and particularly in many women, there is no such counterbalancing physical activity; these suffer early and usually severely.

The treatment of such dyspeptic conditions is difficult if one is restricted solely to dietetic measures. Patients rarely consult the medical man in the early stages when regulation of the diet and life would result in speedy cure. Even when the condition is well established, a simple nutritious diet consisting mainly of milk, fish and fresh vegetable food (native if fresh European vegetables are not to be had), and such fruits as can be obtained, together with temperance or total abstinence in the matter of alcohol, will often result in marked amelioration. Change to a temperate climate is in the majority of cases necessary, and even without restriction of diet marked improvement usually follows, whilst with a carefully regulated plain liberal dietary, complete recovery may be anticipated. The worst cases, however, should be sent to such health resorts as Harrogate, Carlsbad, Homburg, Vichy, and the like, where the combination of a regular life and restricted diet together with carefully regulated exercise, aided perhaps by the waters, will usually restore the health completely. Dyspeptics of this description should not return to the tropics if it can be avoided.

With wealthy natives a similar condition is not uncommon. The actual diet will be different, and the excess of food taken will be not in protein only but in fatty substances also. Although such natives will probably use more highly spiced and flavoured condiments, they are less likely than the European to abuse alcohol. The effects, however, are similar, except that in the native the tendency to obesity is greater and, as little active physical exercise is taken, appears early. Such patients do not submit readily to restrictions in their diet or course of life. The indications, however, are clear; these are to reduce the amount of fats and proteins and to increase the amount of uncooked vegetable food. If this course can be combined with increased exercise, or, if this cannot be done, with long carriage drives, amelioration frequently results.

With the mass of the native population the dietetic errors are mostly due to poverty. As a consequence, there is more or less deficiency in the more expensive protein and fatty foods. The protein and fats consumed are in the main derived from the comparatively cheap vegetables, whilst the bulk of the diet consists of the cheapest cereal available. Rice is the main support of a large portion of the population, and in times of scarcity may be absolutely the only food taken. On such a diet life can be maintained and even vigorous work performed, but the relative proportions of protein, fat, and carbo-hydrate are such that a great strain must be thrown on the digestive powers. In some districts even rice is too expensive for the impoverished population. Sweet potatoes, yams and similar innutritious vegetables become the staple food, with the result that enormous quantities are of necessity ingested, and the stomach becomes permanently dilated from recurring over-distension.

Thus diet may be an actual cause of disease. Excess of protein material in Europeans, and deficiency of proteins in the poorer classes of natives and in some institutions, are instances of this.

A native prison dietary, in use in one of the crown colonies, on which, as regards physical conditions, health may be maintained with little or no loss of weight, will serve to illustrate some of the points above referred to :

	Rice.	Beans.	Vegetables.	Salt fish.	Fresh meat.	
Penal diet .	154 oz.	14 oz.	35 oz.	—	—	per week.
Ordinary diet .	147 ,,	14 ,,	49 ,,	24 oz.	18 oz.	,, ,,

Certain special articles of food are at times causes of definite diseases. Pellagra is reputed to be closely associated with the consumption of Indian corn, maize, in a diseased condition, especially when affected by fungi such as aspergillus fumigatus. Lathyrism is produced by the continued use of *Lathyrus sativus* and possibly of *L. clymenum* and *cicera*. Possibly rice in some of its forms may contain the poison of beri-beri. Ergotism occurs in the tropics as well as in temperate climates.

Certain articles in common consumption are at times poisonous, or may be so if insufficiently cooked. Cassava-manioc (*Mainhot utilissima*) contains a glucoside which in the presence of acids breaks up, setting free hydrocyanic acid. The amount of this glucoside varies with the age of the tuber, and also in different varieties of the plant. In the bitter cassava the amount is considerable, and if the root be eaten only partially cooked, fatal prussic acid poisoning may rapidly occur. Boiling breaks up the glucoside and prolonged boiling expels so much of the hydrocyanic acid that no poisonous effects will be produced. Cassareep, which forms the basis of so many sauces, is obtained by pressing the juice from the bitter cassava and allowing complete fermentation to take place whilst the juice is exposed to the air. If not properly mature a poisonous amount of prussic acid may be contained in this substance, though when fully mature it has all been destroyed.

Articles of food may be contaminated by flies with the organisms of various diseases. Flies are under some circumstances very prevalent and active in the tropics, and as human excreta are less thoroughly dealt with there, these insects are an important factor in the spread of disease. Cholera, as well as typhoid fever, has been shown to be carried in this manner. Cold meats therefore, are dangerous foods, for it may well be that they get contaminated by flies or other insects after they have been cooked and have cooled. Rats, again, may contaminate food with the plague bacillus.

Tinned foods are extensively consumed in some tropical countries. They are frequently more used than they should be as, at the best, their nutritive value is less than that of fresh meat; moreover there is some risk of metallic poisoning. The most serious objection to the indiscriminate use of tinned meats is that it is not always easy to determine whether or not any given tin has been stocked too long. Some of those sent abroad are already old, and others are kept too long in the tropics. The better class of firms do not stock tins very long, but sell off surplus stock to small traders, and so in the remoter districts where these small traders are principally to be found, only very old tins may be procurable. In some cases there is obvious evidence of decomposition, the formation of gas having caused the tin to be "blown," i.e. the concave end to be bulged out and convex. Frequently the vendor perforates and reboils such tins, subsequently soldering up the puncture made. The contents of tins showing two soldered points, therefore, should not be used for food. It is to be regretted that, with the exception of Australasian goods, the stamping of tins with the date of preparation is not compulsory. Ptomaine poisoning from stale tinned food is by no means rare.

The main articles of food used in the dietetic treatment of acute diseases are milk, broths, barley, arrowroot, rice, and oatmeal; to these may be added various proprietary articles such as bovril, Liebig's extract, Valentine's meat juice, and many kinds of malted foods.

Milk.—In many tropical countries, such as West Africa, milk cannot be obtained except in a preserved form. In other countries, cows', goats' or buffalos' milk can be readily procured. The nutritive values of these vary.

Buffalos' milk is very rich in fat, there being nearly twice as much as in cows' milk; it is also richer in proteins though not so rich in lactose. It is less digestible, has a peculiar smell and flavour, and, as a rule, is not suited for invalids.

Goats' milk differs less from cows' milk; but as the goat is susceptible to Malta fever, and the *Micrococcus melitensis* is discharged in the milk of infected animals, it is better not to use the milk of these animals unless efficiently pasteurized or, better, well boiled.

Where cows' milk is available, it should be used in preference to preserved milk. In the tropics, unless milk can be consumed fresh from the cow, it must be boiled, and thus rendered slightly less digestible.

It is necessary to boil milk in the tropics because:

(1) Under tropical conditions the growth of organisms is so rapid that milk quickly turns sour.

(2) The natives frequently add water to the milk and are apt to be careless as regards the washing and scalding of the utensils used.

(3) The water used for such dilution and for washing utensils is usually drawn from shallow wells or pools liable to contamination. Inspection and regulation of the milk supplies in the tropics are very lax.

(4) Obvious impurities are strained off with old rags or articles of clothing actually in use.

(5) Cattle are often fed on garbage of all kinds.

The obvious plan for minimizing the necessity for boiling where the milk is intended for consumption by Europeans, or for use in hospital, is to keep cattle under the best possible sanitary conditions and to ensure that they are milked with due hygienic precautions. This must be done under European supervision.

Fresh milk is better diluted if for use by invalids. In most febrile diseases thirst is excessive, and if considerable quantities of milk are rapidly swallowed, the hard and massive curd which then forms in the stomach is difficult to digest and may tend to increase or induce vomiting, dyspepsia or diarrhœa.

In the acute fevers of short duration, such as malaria and blackwater fever, where the demand for fluid is greater than the immediate necessity for food, the milk given should be freely diluted with soda-water. Where it is less desirable to supply fluid, and nourishment in a concentrated form is required, dilution with barley-water or rice-water is better. The amount added need not be more than half the amount of milk.

Where fresh milk is not available, tinned milk has to be used. The sweetened milks should be avoided. The best tinned milks are those in which the milk is not reduced to a paste but merely concentrated and is still in fluid form. The tin must be carefully examined to see that there has been no second puncture or bulging. The contents must be odourless. A tin once opened must be used quickly. The highly sweetened milks will keep fairly well, but with the unsweetened, and these only should be used for invalids, immediate consumption is necessary.

In making either **rice-water** or **barley-water** it is essential that the rice or barley should be washed with many changes of water until the water comes away quite clear, and then boiling water should be poured on and poured away to complete thoroughly the cleaning of the grains. Finally the barley (4 tablespoonfuls to the quart, or rice 2 tablespoonfuls) should be placed in cold water which is slowly brought to the boil and maintained at that temperature for one hour. Till native servants are well trained, much supervision is required, and the washing of rice before making rice-water is apt to be neglected or imperfectly performed, especially by the Chinese.

Broths.—Chickens or fowls can always be obtained, and chicken broth is on the whole the form of broth best suited for invalids. In certain countries custom or religion interdicts the use of several kinds of animal food, but chicken broths can be taken by nearly all natives whatever their religion may be.

At times various meat preparations, Liebig's extract, bovril, etc., have to be used, but they should be relied on as little as possible. They apparently keep well, and but few cases of ptomaine poisoning have been attributed to their use.

The **dietary during convalescence** is most important. Many relapses in diseases both of the alimentary canal and of other organs are due to dietetic errors. The appetite of patients varies ; with some after a single short attack of illness it is voracious, and with natives it often takes the form of an intense craving for a heavy meat meal which, if gratified, will usually prove injurious, and may produce a fatal relapse. Part of this craving is due to a too slow return to a liberal dietary, and particularly to unnecessarily prohibiting solid but easily digestible foods. Fish, eggs, milk puddings, bread and fresh vegetables can be allowed early in convalescence in most febrile diseases. Large meals should not be permitted ; frequent small feeds are safer. Some food should be provided for the middle of the night, if desired, as an interval of twelve hours between meals is too long for a convalescent who is inclined to be ravenous.

In other cases, although the actual disease is over, there is a disinclination for any food ; in such convalescence is much retarded. This disinclination may be the result of some complication which requires treatment. Sometimes, as in malaria, it is due to quinine and the consequent atonic dyspepsia. In other cases it is due to anæmia. Change of air has often a markedly beneficial effect. Drugs given by the mouth should be used as little as possible. Forced feeding or undue pressure are not to be employed. Small but tasty and nutritive meals should be provided, and more should not be given at any one time than the patient can easily digest. Fruits are often readily taken under such conditions, and bananas and various other fruits are actually beneficial. Alcoholic stimulants, except light wines, should be avoided. The fluid from the interior of the cocoanut—cocoanut milk—can be taken when quite fresh, but not when there is acute disease of the alimentary canal. It is contra-indicated also where there is flatulence. It must not be drunk in large quantities.

The dietary in most of the tropical diseases is to be regulated largely by the tastes, inclinations and resources of the patient, and controlled by the exercise of common sense and the application of general principles.

Natives of the poorer classes may be assumed to be underfed, particularly as regards nitrogenous food. In chronic, more or less incurable diseases, such as leprosy, the effects of a liberal dietary including abundant fatty substances are most marked, the general condition improving greatly and the disease for a time appearing to retrogress.

Europeans more often have overfed on a highly nitrogenous diet, combined sometimes with the consumption of alcohol in excess of the physiological standard. In such a light, sufficient, but not excessive diet results in an improvement in the general condition.

It is, as a rule, useless to attempt to feed during an acute febrile condition where there is an actual disinclination for food. During convalescence, restraint is necessary; at the same time the patient must not be starved.

MALARIA

The benign malarial fevers call for no special dietary. During the febrile paroxysms food need not be given; if given it would probably not be retained. Fluids may be taken freely, and such as promote diaphoresis are to be recommended. Hot tea is often retained better than cold drinks, and if given weak is beneficial. Various hot drinks, such as lemon decoction, infusions of lemon grass or other faintly aromatic substances are also useful. In the apyrexial intervals, light but not slop diet may be taken freely, unless there is persistent gastric irritation.

In the so-called malignant malarial fevers the pyrexial attacks last longer, but as the attack can usually be treated effectively in two or three days, it is not necessary to force much food on the patient. Any food that is given should be in a fluid form. Milk and soda-water, if given in small quantities at a time, is usually retained even when there is a considerable amount of vomiting, Food that is not vomited is usually digested.

In all cases of malaria a light diet, consisting of fish, fowl and vegetables, with a little red meat, may be taken during convalescence. Care must be exercised to vary the diet, as there is often distaste for food, partly from the disease and partly from the effects of the quinine used in the treatment. Stimulants are not required during an ordinary attack of malaria. In the graver cases and in young children they must be used if there be any sign of cardiac failure.

BLACKWATER FEVER

As in malaria, the individual attack is of short duration, nevertheless during this brief period an extreme degree of anæmia is attained. The greatest danger is suppression of urine; consequently the main dietetic requirement is the maintenance of an abundant supply of fluid in order to flush the kidneys. Nutriment, though important even during the acute stage, is less so than water.

Vomiting is a marked symptom in most cases, and is often a precursor and concomitant of suppression of urine. Every care, therefore, must be taken that fluid and diet be so arranged and administered as not to provoke this symptom. Food in liquid form, such as milk and soda-water or cooled broth, may be given frequently in 1 or 2 oz. doses, whilst the patient is kept perfectly still and hot applications are made to the epigastrium. If vomiting supervene, food must be discontinued, although plain fluids may still possibly be given by the mouth. Rectal alimentation can be employed, but as frequent saline enemata must be given, the bowel may become irritated, in which event there is little chance of absorption taking place; recourse must then be had to frequent subcutaneous injection of normal saline fluid. Stimulants will be required to combat the tendency to cardiac failure; they should not be resorted to at first, although they may be required by the second day.

The obstinate hiccough that sometimes occurs is difficult to treat. In some cases it may be relieved by solid food, such as dry biscuits. Occasionally what is known as the "prairie oyster" has a good effect. It is made by turning out the unbroken yolk of an egg into a wineglass, into which a teaspoonful of Worcester sauce and half a teaspoonful of whisky have been poured. The unbroken yolk should be well covered with black pepper. The wineglass is then rotated so that the whole surface of the yolk is wet with the sauce. The yolk should then be swallowed whole.

If food be retained it is well digested. During convalescence a light ordinary diet can be adopted. No restrictions, beyond care as regards the amount, quality and digestibility of the food (so as not to cause any attacks of dyspepsia or gastric dilatation) need be enforced.

YELLOW FEVER

In this disease gastric irritability, shown at first by acid vomiting and later in the grave cases by the vomiting of altered blood—black vomit, is usually present. The early vomit may be bilious, or consist simply of more or less digested food. The later vomits are excessively acid. Strength must be maintained and fluids should be freely supplied to combat the tendency to suppression of urine. Hæmorrhage occurs readily from all mucous surfaces, and therefore rectal alimentation cannot be relied on.

The method of administration of food is important. It must not be in a solid or too concentrated a form and should be given frequently in very small quantities and well iced. Milk well diluted, preferably with soda-water, to which is added some carbonate of soda, 2 grains to the ounce, is as suitable as any. Iced soups, coffee and stimulants in the form of a light white wine, may be given.

The intense congestion that is present in the mucous membranes during the acute stage of the disease may pass off rapidly, but it does not always do so. A strict and very spare diet therefore must be maintained for at least a week after apparent convalescence, the amount given at a time being gradually and cautiously increased.

RELAPSING FEVER

During the febrile paroxysm, which lasts up to a week, light fluid diet only can be taken. The tendency to collapse at the time of the crisis renders it necessary that nourishment be systematically administered. Towards the end of the fifth or sixth day when the crisis may be expected, stimulants are necessary, and may have to be given in large quantities if marked collapse occurs.

The jaundice, so common during the attack, will disappear spontaneously; the critical diarrhœa, though often dysenteric in character, will also subside soon after the crisis. When purging ceases, ordinary light diet may be resumed till the next febrile attack. Constipation, as well as vomiting, usually precedes and is associated with the onset of the fever, so that towards the time when relapse is due a return to fluid diet is indicated.

DENGUE FEVER

No special diet is necessary. The ordinary dietetic treatment of a febrile condition may be followed. If the articular pains are severe or persistent, meat should be avoided.

MALTA FEVER

A liberal dietary is requisite as this irregular fever may last for months or even years, and great debility and anæmia ensue. When the temperature is high, fluid diet only can be taken, but as soon as possible this must be supplemented with eggs, fish, and light farinaceous food. Meat must be avoided, and also heavy meals, even during the intervals when there is little or no pyrexia, as any gastro-intestinal disturbance may precipitate a relapse.

Prevention.—In visiting any port where Malta fever is endemic—practically most ports on the Mediterranean—special precautions with regard to milk are necessary. Cows' milk is safe ; but as goats' milk is so largely used in these places, it should be made a rule that only boiled milk be consumed. It is advisable during brief visits not to take milk at all—not even with tea or coffee unless thorough boiling can be relied on.

KALA AZAR AND TRYPANOSOMIASIS

In these chronic febrile conditions, no special diet is required. Although light, the food must be abundant, nutritious, and varied, as in both diseases wasting and debility occur. In the apyrexial periods, solid food can be taken with impunity, but it should not be bulky or indigestible. In the later stages of kala azar, there may be intestinal ulceration or simply diarrhœa ; in such cases, or even at an earlier stage, if intestinal symptoms are present, a light fluid diet, mainly of milk and barley-water, arrowroot, etc., should be adopted.

BERI-BERI

Diet in beri-beri has to be considered mainly as to its effect in causing any embarrassment of the heart. The nerve supply to the stomach is usually impaired, and there is a great tendency to dilatation of that organ. This may occur however carefully the patient is fed, and will increase the tendency to the cardiac failure which is the usual cause of death in this disease.

Therefore, bulky food and any food which is likely to remain long in the stomach and be slowly digested must be avoided. In serious cases milk, mixed with barley-water in equal parts and given in small quantities at a time, is the safest diet. Soda-water should not be given with the milk. Egg and milk is a good mixture. Strong soups or broths given in small quantities are also permissible. Bulky farinaceous foods, such as rice and potatoes, should not be given, even when the acute stage appears to have been passed. Milky puddings, custards, and bread may be added to the diet as the acute symptoms pass away; when convalescence sets in fish, eggs, meat and small quantities of potatoes (mashed) may be added. Even for a convalescent the total amount of food or fluid taken at a time must be carefully regulated, seeing that some impairment of the innervation both of the heart and the stomach may still be present.

As the actual bulk of ingested material is so important in serious cases of beri-beri, the restrictions as to the amount taken must be extended to fluids as well as solids, even to water. The patient must never be allowed free access to food or fluid of any kind. An additional reason for restriction of fluid lies in the circumstance that in all cases there is more or less œdema, and in some an excess of fluid in the serous cavities, slight it may be in some cases but excessive in others. Some authorities attach much importance to the restriction of the total amount of fluid, as well as to the amount given at a time. One pint of fluid in twenty-four hours is by them considered to be sufficient.

Vomiting in this disease is usually a sign of a fatal termination. It is not so, however, from anything special about the vomiting, but as an indication of the extent of the nerve lesions, especially as regards implication of the pneumogastric.

In many cases there is marked congestion of the mucous membrane of the stomach and intestines, and also of all the abdominal viscera and particularly of the liver. The degree of congestion is greater than can be attributed merely to back pressure from cardiac dilatation and failure; it is probably due to a combination of this and of vasomotor paralysis. The condition, however, renders the restriction of diet and the avoidance of any irritating foods, stimulants or drugs, still more necessary.

A further reason against the use of rice as an article of food in beri-beri, is that there is some reason to suspect that the poison which causes the neuritis is contained in certain kinds of rice, and that the injurious effects in acute cases are not due merely to the bulkiness of this food.

In the case of Europeans it is mainly on board ship that beri-beri occurs. Usually, under such circumstances, there is little choice of diet.

As compared to Europeans beri-beri is much more common amongst the coloured races, and particularly amongst rice eating natives, such as the Chinese. Economical considerations, as well as the craving that such people have for rice, may render it impossible to prevent its use to some extent after the acute symptoms have subsided. Under such circumstances, it is better to allow only freshly husked rice or such rice as has been previously treated in the Indian manner by boiling or steaming on garnering and before husking. In these forms it is considered by some that rice does not contain the toxin of beri-beri. Cheap bread and biscuits are sometimes made in part with rice instead of wheat flour, and must therefore be viewed with some suspicion when they become a staple of diet, as on board ship and in large institutions. In beri-beri countries the dietaries in fleets, military camps, gaols, mining camps, schools and charitable institutions must be so arranged that they shall include an adequate amount of nitrogenous and fatty material and fresh vegetables.

ANCHYLOSTOMIASIS

In uncomplicated cases, no special dieting is required except that preliminary to the treatment for expulsion of the worms. The patient after treatment should be well fed; a liberal diet including meat is indicated. In some cases, undigested food is passed per rectum, probably as a consequence of catarrhal enteritis or of fatty degeneration of the pancreas. In such cases, careful dieting may be necessary. Meat finely divided and lightly cooked may be better digested than the same article of diet cooked in the ordinary manner. Milk diluted with barley-water, so that only small curds are formed, may be given; if this is not properly digested it should be peptonized or pancreatized.

The dieting preliminary to the active treatment for the expulsion of the worms varies to some extent with the anthelmintic to be employed. In all cases, however, the diet should be light and mainly fluid for forty-eight hours before the treatment is commenced, and no food should be taken for twelve hours before the anthelmintic is administered. Usually the last meal is taken at 6 p.m., and no food is given till after the full course of the drug treatment has been carried out early on the following morning.

If the anthelmintic selected has been thymol, no alcohol and no oils should be given before, or for at least twelve hours after, the exhibition of the drug.

FILARIASIS

In the febrile conditions associated with this group of diseases light fever diet is all that is required, or that the patient would care to take.

In chyluria the amount of discharge in the urine and the milkiness of it vary with the character of the food taken. A too fatty diet, therefore, should be avoided, as it distresses the patient without benefiting him in the least. Repair of the ruptured lymphatic, which is the immediate cause of the presence of the chyle in the urine, is facilitated by temporarily eliminating all fatty material from the diet, and restricting the intake of fluid.

BILHARZIASIS

The actual discharge of blood is due to local lesions, and no special dieting is required in many cases. It is, however, so often associated with cystitis and still more frequently with irritability of the vesical mucous membrane, that those articles of diet which act as stimulants or irritants of the bladder wall should be avoided. Red meats, alcohol, salted meats, coffee, vegetables containing oxalates, very acid fruits, spices, etc., should be interdicted and a diet such as would be suitable in chronic cystitis habitually observed.

PLAGUE

During the acute stages of the disease food in a concentrated fluid form such as strong soups, broths, and milk should be given. As cardiac failure may occur during convalescence, stimulants must be administered early, and increased when cardiac failure appears imminent. The patient requires good nourishing food during convalescence, but it must be given in small quantities so as to avoid any over-distension of the stomach.

During an epidemic all articles of food must be carefully preserved from contamination by rats, as the plague bacillus may be introduced by the mouth and infection may take place through trivial lesions in the buccal or intestinal mucosa. Such contamination is prevented by keeping the food in a rat-proof store. During an epidemic, also, all the food should be thoroughly well cooked so as to destroy any plague bacilli which may have found access to it.

GASTRO-INTESTINAL DISEASES

General principles.—Regulation of the dietary plays an important, if not the most important, part in the management of the various morbid conditions to which the alimentary canal is so peculiarly prone in the tropics, and which constitute a principal feature in tropical pathology. Although in consequence of diversity in the circumstances of the individual cases, as well as of the diseases and in the degree of their severity, the details of dieting and management necessarily vary, there are certain general principles which serve as guides in elaborating these details. In proportion to the care and thoroughness with which these principles are applied will be the success of the practitioner.

In treating the diseases of the alimentary canal the condition and functions of the affected organs must ever be kept in view, and this more especially when the physician is directing the dietetic part of the treatment. He must not be influenced too much by the name of the disease; he must rather picture to himself the exact physical condition of the affected organs, recognizing that they are congested, inflamed, or ulcerated and, it may be, functionally perverted. At the same time he must not forget that their operation is necessary for the nutrition of the body; and, seeing that the diseased organs themselves are a part of the body, he must bear in mind that their recovery cannot be effected unless they themselves, as part of that whole, are also adequately nourished.

Such considerations suggest the leading indications for the dietetic as well as for the more strictly therapeutic management of the various forms of acute and chronic disease of the alimentary canal special to the tropics, and of which intestinal flux is usually a leading clinical feature. These indications may be summarized as follows—

1. The removal or suppression by drugs—quinine, ipecacuanha, calomel, purgatives, antiseptics, anthelmintics, etc.—of such specific organisms as are either the primary and sole cause of the disease, or which may be contributory agents in the production of and continuance of secondary morbid conditions.
2. Rest of the affected organs so far as is consistent with
3. Adequate local and general nutrition.

It is with the second and third alone of these indications that we are here concerned. They are best met, first, by the selection of the appropriate kind, quality and amount of food; and, second, by insisting on warmth and strict rest in bed in order to allow of reduction of the amount of that food to the lowest possible minimum compatible with the general and local physiological necessities. These are golden rules for the management of the grave tropical intestinal fluxes, whether acute or chronic; they can seldom be disregarded with impunity.

CHOLERA

During the **acute stage** of cholera food is out of the question. If swallowed and retained it can only do harm, for in the condition of the stomach at this period of the disease digestion and absorption are in abeyance and all foods, whether liquid or solid, are no better than foreign bodies; their administration therefore can only do harm. Water is the only thing permissible. This may be drunk *ad libitum*. If absorbed, even in small amount, it will help to dilute the thickened blood and flush the kidneys ; if vomited it will carry out with it myriads of cholera vibrios and their products and to that extent proportionately improve the chances of recovery. If the patient can be got to take the water he craves for slightly warmed so much the better.

At a **later stage** of the disease when vomiting and purging subside and the pulse is returning and when urine begins to be secreted the question of food and drink becomes important. The epithelial layer of stomach and intestine has been completely shed, the blood vessels are nearly empty, the patient is in a state of collapse or of great prostration. In such circumstances to give food or stimulant in large amounts would only tend to interfere with the process of repair necessary for re-establishment of the digestive and absorbing faculties, and would very likely precipitate a severe gastro-enteritis. Food and fluid, therefore, must be very cautiously introduced. Milk, peptonized if possible, and freely diluted, thin barley or rice water, egg-albumin water, and very weak chicken, mutton or beef-tea are indicated, beginning with teaspoonfuls every quarter of an hour and gradually increasing the amount and strength, the interval between the feeds being at the same time lengthened *pari passu* with the improvement in the condition of the patient. But there must be no attempt to force feeding or at returning to solid food, more especially if there be indications in the form of the slimy or bloody stools of enteritis. Until all such evidences of enteritis have completely disappeared, and appetite and digestion are thoroughly re-established, solid food must be withheld, and even then care must be exercised for a time, both as regards the quality and quantity of the meals.

Should the condition known as **cholera typhoid** supervene on the acute stage of the disease, fluid diet of as nutritious and concentrated a character as can be digested and at the same time not aggravate any existing enteritis, must be sedulously administered every two or three hours, or at shorter intervals, day and night. If the urine is scanty or suppressed, the patient should be encouraged to drink water freely but not in such quantity as to induce vomiting. If vomiting is present, the water should be given by enema of weak salt and water, a teaspoonful of the former to a pint of the latter; or, if this be rejected, by subcutaneous or intravenous injection of sterilized physiological salt solution. Wine or other alcoholic stimulants may have to be given; they should be well diluted and administered in small amounts at short intervals.

In all cases of **recovery from cholera** the return to ordinary diet should be gradually effected.

During an outbreak of cholera great care should be taken to avoid any articles of food that would cause dyspepsia or reduce the normal acidity of the stomach contents. For this reason, fruits should be taken in great moderation or not at all. Melons are by some believed to be particularly unsuitable and to predispose to an attack. As water passes through the stomach without exciting secretion of acid it should not be taken between meals, and not in large quantities with them. In all circumstances it should be thoroughly and recently boiled and not filtered *afterwards*.

ACUTE DYSENTERY

In the suddenly developed and urgent types of dysentery —usually bacillary in origin—it is advisable, unless the patient from some special cause, such as starvation, is in a very prostrate condition, to withhold all food with the exception of very thin barley-water or rice-water for the first twenty-four or thirty-six hours, and until the first burst of the disease has to some extent spent itself. Fluid, however, must be supplied and may be given as plain water, or egg-albumin water, or in the form of the highly diluted farinaceous drinks mentioned. It is important that the amount administered at a time be small and, also, that it be at an appropriate temperature. Large draughts of fluid, especially of very hot or very cold fluid, tend to provoke peristalsis and thereby irritate the inflamed colon and aggravate the tenesmus and tormina from which the patient is doubtless suffering. It is advisable, therefore, **during the first day or two** of acute dysentery to direct that the patient shall receive a wineglassful of slightly warmed fluid of the description named every two hours, that it be administered in teaspoonfuls, and that no other food or drink whatever should pass the lips.

By the second or third day of the disease provision will have to be made for the regular and adequate nutrition of the patient. In arranging for this the state of the colon—inflamed, possibly about to ulcerate or slough—must ever be present to the practitioner's mind. It must be kept at rest as far as possible, and irritated by the passage of fæces as little as possible. Usually at this early stage of acute dysentery the entire alimentary tract—apart from the colon—is in a state of catarrh, the tongue coated, the gastric digestion feeble. It is evident, therefore, that liquid diet has to be continued, and it becomes an urgent question as to what form of liquid diet is the best.

Experience has generally shown that so long as the tongue is thickly coated, milk unless highly diluted is not well digested, curd appearing in the stools and doubtless aggravating the griping and purging. As a rule, **until the tongue cleans,** barley water, rice water, egg-albumin water, very thin chicken or mutton broth, rice or barley water in which chicken has been boiled, or chicken jelly constitute the most appropriate foods, the precautions already mentioned as regards quantity and temperature being observed. **When the tongue has cleaned** and when it may be inferred that gastric digestion has improved, milk, at first well diluted and peptonized, or raw egg and milk may be gradually introduced, and along with rice or barley-water should constitute for many days the staple and only food. As an all round food in dysentery, whether acute or chronic, when it is desired to give the patient the maximum amount of nourishment with the minimum amount of irritation, there is no food better adapted or more readily procurable than milk and rice or barley-water, in the proportion of two of the former to one of the latter. If desired a little salt may be added, or the mixture may be peptonized. It should be given slightly warmed, sipped with a teaspoon, and in quantities of from 5 to 10 oz. every two or three hours. If the monotony of this diet is complained of, one of the many malted foods on the market may be given occasionally as a substitute.

Later, **as the stools improve** and are free from blood, well boiled arrowroot, cornstarch, semolina, tapioca, revalenta and the like may be added. **When the stools are formed** hot milk and bread, chicken panada, rusk, boiled white fish, underdone egg, custard, light milky pudding, and well boiled rice will gradually pave the way to a slow return to ordinary diet. Fresh vegetables sooner or later are a necessary element in every dietary, but their introduction into that of the dysenteric patient must be cautiously effected. Coarse vegetables of the cabbage kind are injurious. Well boiled, mashed and then baked potato, stewed or roasted apple, well boiled Spanish onion, and fresh cauliflower appear to be the most suitable. They must not be given in large quantity, and their influence on the stools must be carefully watched.

For a long time **after convalescence has been thoroughly established** the diet must be attended to and carefully restricted as to quantity as well as to kind. Red meat and alcohol in every form must be sedulously avoided, as well as the coarser foods such as are mentioned under the section of chronic dysentery. On a threat—no matter how trifling—of **relapse** all solid food must be at once discontinued, and a milk and barley or rice-water diet resumed, together with rest and warmth and appropriate medicinal treatment.

CHRONIC DYSENTERY

For some time after recovery from acute dysentery, and in the various types of sub-acute relapsing dysentery and of chronic dysentery of tropical origin, and which are usually associated with the presence of *Entamœba histolytica* in the stools, diet is of the utmost importance, but, unfortunately, to lay down a dietary which would be suitable to every case is impossible. Almost every case has its special features requiring consideration; hard and fast rules, therefore, are not applicable. In regulating the diet of these cases the effect of the various foods we introduce should be watched most carefully, not only on the stools which, if possible, should be inspected daily, but also on the general nutrition of the patient.

Idiosyncrasies in the matter of food are not uncommon and have to be taken into account. Mental peculiarities have also to be considered and care may have to be exercised by avoiding a too sedulous interest in every little article of diet, or by too particular an inspection of the stools, to avoid fostering, or creating even, hypochondriacal tendencies not at all uncommon in chronic dysenterics. Some patients attach little importance to a moderate degree of chronic dysentery and consequently may be foolishly careless; on the other hand, there are not a few who become morbidly sensitive about the slightest irregularity, whether it be in the colour, consistence or smell of their dejecta, and are thrown into a fever of alarm by the appearance of the slightest looseness or streak of slime. Such people are apt to become a nuisance to the physician and a burden to themselves. They are over-careful. They live by theory; ignoring the promptings of their natural appetite they not infrequently land themselves in a condition of physiological starvation far from conducive to recovery. Patients with this tendency should not be instructed to watch their stools; they should be instructed rather to attend to a reasonable extent to any healthy natural appetite they may develop.

Circumstances may compel some chronic dysenterics to work hard, whereas others may be under no such obligation; some may be naturally robust, others delicate; some, apart from the disease of the bowel, may be constitutionally sound, others may be the subjects of tuberculosis, syphilis, malaria and so forth. The possibility of the existence of hepatic abscess must also be borne in mind. In prescribing a dietary in chronic dysentery all these things have to be considered and allowed for.

There are **certain drinks and foods which all chronic dysenterics should avoid.** Chief of these is alcohol; this, under every form, unless in very exceptional circumstances, should be strictly forbidden. Partially fermented drinks, such as gingerbeer, and sweet effervescing drinks, as bottled lemonade, perry, and so forth are dangerous ; strong tea and black coffee are in the same category. Iced drinks or large draughts of fluid, especially at meal times, should also be avoided.

The following articles of food are generally inadmissible : Rich soups, strong beef-tea ; oily fish such as salmon, trout, eel, mackerel, herring, smelt ; shell fish such as lobster, crab, shrimp, prawn ; dried, salted or otherwise preserved fish such as Bombay duck, smoked salmon, red herring, dried haddock, salted cod, sardines ; red meats as beef, mutton, pork, venison, hare ; all birds of the duck tribe as duck, goose ; rich sauces, curries, potted or otherwise preserved meats ; coarse vegetables such as cabbage, Brussels sprouts ; dense vegetables such as peas, beans, carrots ; nuts of all kinds ; raw vegetables and salads ; dried, candied, or otherwise preserved fruits such as raisins, currants, orange peel, crystallized fruit, preserved ginger, jams and pickles.

Although interdicting certain foods, in prescribing a dietary in chronic dysentery, we must bear in mind that the disease may run a very long course, and that too monotonous or restricted a diet if persisted in for many weeks or months may induce scorbutic conditions, or, if not actual scurvy, at all events depraved conditions of nutrition not conducive to recovery. It will generally be found that these cases do best on **a mixed diet with short courses of a more rigid dieting** and more energetic medicinal treatment interpolated from time to time.

Thus in those cases of chronic or recurring tropical dysentery so frequent among our countrymen from India, if the general condition be fairly satisfactory, and if there be no evidence of liver abscess or of tuberculosis of an advanced character, we may prescribe with advantage a course of ipecacuanha in large doses. At the same time we insist on rest in bed and a diet of milk and barley-water only, to the amount of 3 pints in the twenty-four hours. This course of active treatment is to be continued for a week or ten days. Thereafter the diet should be gradually changed and eggs, rusks or thin toast, arrowroot, well boiled rice, chicken broth, boiled fish, pounded chicken, mashed potato, milky pudding, stewed apple and so forth gradually introduced, one article at a time. So soon as it is found that the patient on this increasing diet has begun to gain weight the further increase of food is suspended as being unnecessary, but care must be taken to vary as much as possible the kind of food and the way in which it is cooked. A rule of great importance should be insisted on, namely, that food must never be taken in the absence of appetite.

As effective mastication is indispensable the physician must see to the teeth and gums, and the services of the dentist be invoked if indicated. Oral sepsis must be corrected.

In time some such **diet as the following may be gradually worked up to:** Breakfast: One or more of the following: Hot milk and toast or bread, lightly cooked egg, boiled sole or other white fish, thin toast, rusk or pulled bread, a little fresh butter, small cup of weak China tea or of chocolate. Lunch: Slice of fowl with bread sauce, or a piece of boiled fish, mashed potato, cauliflower, milky pudding or stewed apples. Five o'clock: A glass of milk and a rusk. Dinner: The same as lunch. Bed time: A glass of hot water, or of hot milk, or a cup of some malted food. Small quantities of fresh fruit may be taken, in many instances with great advantage.

On such a diet the patient may thrive and gain weight. Should this prove to be the case there must be no undue haste to change the regimen; at the same time, when any particular article of food begins to pall a substitute should be found, a too rigid monotony being carefully avoided. In some very chronic and persistent cases with marked tendency to relapse a good plan is regularly, and as a matter of routine, to suspend the mixed diet for one day a week, give the patient some mild aperient and place him for twenty-four hours on milk and barley-water only. Relapse is anticipated in this way, and it may be averted.

Whenever a **relapse is threatened** the diet of milk and barley-water must be at once resumed, the patient being sent to bed and active medicinal treatment instituted. By prompt action of this description and by persistent care in the feeding and general hygiene, most chronic dysenteries can be got rid of, if not promptly, at all events in time.

Other methods of dieting will be alluded to in the section on sprue.

There is one fact, with important practical bearings, that is too generally overlooked in the management of the various forms of dysentery, namely, the capacity for prolonged latency possessed by the germs responsible for the specific lesion. Once established in the colon these germs may be difficult to uproot completely; especially is this the case with the amœba. A well directed treatment may have brought about apparent recovery, but on slight provocation, i.e. anything tending to cause intestinal irritation or congestion, such as alcohol, strong coffee, bad food, inappropriate food, too much food, especially red meat, chill, etc., the parasite may find its opportunity in the irritated tissues or deranged secretions, and after perhaps months or even years of quiescence once more start into activity and produce dysenteric lesions and symptoms. In some cases there appears to be a rough periodicity about the recurring relapses, as if these were determined by definite periodical biological changes in the parasite. In time, as with the malaria parasite, the infection appears to die out, but as in many cases this may be a long time, several years, one cannot be too careful in pronouncing a chronic dysentery as cured, or in relaxing dietetic and other precautions.

SPRUE

In no other disease is it more necessary to enforce the principles of physiological rest together with an adequate supply of digestible non-irritating food than in sprue. The patients, as a rule, are wasted and anæmic, the mucosa of the alimentary canal from mouth to anus is inflamed, eroded in places and exquisitively sensitive, the stomach and intestine are distended with gas, the glandular and absorbing tissues of the bowels are inflamed and perhaps partially destroyed, the muscular coats are wasted, the liver small, and the pancreatic and biliary ducts are catarrhal; whilst the stools are pale, phenomenally abundant, fermenting, loaded with fat globules and air bubbles, and usually loose and frequent, especially so in the morning and early forenoon.

The disease is very persistent and generally progressive and, unless arrested or cured, will terminate sooner or later in death by inanition, even if no secondary infection supervene.

Experience has shown that drugs play an insignificant part in the management of this disease, which as regards the European is one of the commonest and most fatal of tropical maladies. Its etiology is unknown. The specific germ, if there be one, has not been recognized, nor has any remedy which might be regarded as specific been discovered. Drugs, therefore, play a very secondary rôle in its management; nevertheless, if properly taken in hand and at a stage sufficiently early and before the digestive apparatus has been hopelessly destroyed, and if the patient is otherwise of sound constitution and under fifty years of age, much may be effected by proper treatment.

Various methods of dieting have been advocated and are used either singly or in combination. They may be classified as follows:—

I. The milk diet.
II. The meat diet.
III. The fruit diet.
IV. The mixed diet.

I. The milk treatment.—Of these methods the most generally applicable and effective is the first—the treatment by an exclusively milk diet. It ought always to be tried in the first instance. Its success depends, in great measure, on the strict observance of the minutest detail, a fact that must be thoroughly impressed on and apprehended by the patient and his responsible attendants.

The patient is sent to bed in an airy sunny room, in which the temperature is kept uniformly above 60° Fahr. He should be clothed in flannel, and during the day when reading should wear a long sleeved shoulder wrap. The abdomen should be covered with a large cotton-wool pad firmly kept in position by a flannel binder. He must not be allowed to get up, but must use the bed pan when necessary.

Should pyorrhœa alveolaris or other condition of oral sepsis be present, as is often the case in this disease, appropriate local treatment must be instituted.

The bowels, in the first instance, had better be cleared by a small dose of castor oil or of pulvis rhei composita, the patient abstaining from all food pending the action of the aperient. Written directions are then given as follows.

1. Fresh milk, slightly warmed, to be the only food and drink.

2. The milk to be taken at intervals of two or of three hours, in divided quantities up to the aggregate amount of 3 pints in the twenty-four hours.

3. The milk must never be drunk down hurriedly, but slowly sipped with a spoon or sucked through a straw or fine glass tube in imitation of the natural way of ingesting milk.

4. After each feed the mouth must be rinsed out with an alkaline or antiseptic wash, and the teeth lightly brushed.

5. Unless the patient is very weak sleep must not be disturbed for feeding purposes.

6. If at any time there is a feeling of nausea or a want of appetite, one or more feeds should be intermitted.

7. Throughout the treatment the patient's weight should be taken every three or four days and accurately recorded.

If after a thorough trial of this treatment for a week there is no marked improvement, the diet must be modified. If, on the contrary, as is usually the case, improvement is marked attempts to increase the amount of milk must not be made too soon, not, indeed, till the patient clamours for more food and the motions are solid. In this case increments to the extent of half a pint per diem may be conceded every two or three days. When in this way the patient is taking 6 pints of milk, he usually begins to gain weight and may now be allowed to get on to the sofa or sit up for a few hours at a time, carefully clothed and in a warm room. Later, when he is on 7 or 8 pints a day, he may get out of doors on fine days with the usual precautions against chill, but he must not be allowed to take anything approaching active exercise.

Not until six weeks after the stools are formed and the soreness of the mouth and the abdominal distension have disappeared may any attempt be made to add to the dietary. It is well to put this off as long as possible, preferably until some indication of bile has appeared in the stools. When it is deemed advisable to add to the dietary such additions must at first be made tentatively and in small quantities, a corresponding amount of milk being deducted and the effect on the tongue and stools carefully observed. Any tendency to relapse must be at once regarded as indicating that the added food is unsuitable or premature, in which event a gentle aperient should be given and the exclusively milk diet reverted to until the temporary disturbance has subsided.

Provided that things are going well the following may be carefully introduced: Fruit, especially strawberries or bananas mashed up with a portion of the milk; raw or underdone eggs; well-boiled arrowroot, rice-water or barley-water; rusk, crisp thin toast, or pulled bread; custard, malted artificial food, stewed apple, chicken broth in which rice has been boiled and strained out; pounded chicken, chicken cream or panada; boiled sole or turbot; boiled, mashed and afterwards baked potato; and so gradually after several months reverting to regular meals and ordinary diet, but for a long time interdicting everything but the simplest and most digestible of food, and avoiding alcohol and beef, and unnecessary fluid at meals.

As already directed, the patient's weight must be frequently and regularly ascertained with the view not merely of avoiding underfeeding, but of obviating, what is equally dangerous, over-feeding. There must be no attempt, as is so often done, at pushing the milk or extras. A small weekly gain in weight of a pound or two indicates that nutrition is being efficiently conducted. To give more food in such circumstances is not merely unnecessary but it is dangerous, risking as it does an interruption of the physiological rest which our measures are directed to secure as far and as long as possible. For the same reason, as it obviates the necessity for large quantities of heat producing food, clothing should be warm; and, because it obviates the necessity for muscle-forming food, exercise should be reduced to a minimum. It seems hardly necessary to insist on what seems so obvious, were it not that experience shows that it is in consequence of the ignoring of these rudimentary principles that the milk treatment so often fails, in some instances, to cure or, at all events, to ameliorate the disease.

It sometimes happens that the milk treatment in this form fails from the outset; symptoms instead of abating increase and the patient rapidly runs down hill; or it may happen that after a period of temporary improvement the milk seems no longer to suit him; or, again, that it agrees with him so long as only 3 or 4 pints are consumed, but so soon as attempts are made to increase the amount diarrhœa and sore mouth return. Notwithstanding this apparent initial failure, it is inadvisable altogether to abandon the milk treatment without further effort. Reducing the amount, peptonizing or boiling the milk, diluting it with water or barley-water, condensing it by evaporation in a shallow dish placed on boiling water, and stirring the milk to prevent the formation of scum—which should it form must be discarded, giving it in the form of skimmed milk, or koumiss, or whey, or buttermilk, or in some form of clotted milk may be tried. In one or other of those ways success is sometimes attained. Not infrequently the addition of a little fruit, especially of strawberries, succeeds when milk alone fails, and certainly should be tried when possible.

In certain cases, so long as the total amount of milk consumed in the twenty-four hours does not exceed 3 or 4 pints, it is digested and absorbed, but whenever this inadequate amount is exceeded relapse occurs. In a proportion of instances the failure appears to depend on inadequate absorption of the watery element in the milk. In such instances the requisite amount of nourishment may be supplied by evaporating say 6 pints of milk to 4 or 3. Recently the use of buttermilk, and of living lactic acid ferments, etc., introduced with each feed of milk, and in other ways have been strongly advocated in sprue and chronic dysentery. It is claimed that by acidifying the contents of the alimentary canal, these organisms suppress the bacteria of putrefaction and so, being themselves harmless, conduce to recovery. This method is well worth a trial when milk in its ordinary form has failed.

One or other of these modifications of the milk treatment should be tried before the method is definitely abandoned. Should they fail one after the other, recourse must be had to some other method of feeding, the same careful observance of rest and warmth still being insisted on.

II. The meat treatment.—When it is deemed advisable to have recourse to this system of dieting, either from the outset or in consequence of failure of the milk treatment, it is well to commence with teaspoonful, gradually increased, to tablespoonful, doses of carefully prepared meat juice. If this is well borne scraped meat and, later, minced and lightly cooked meat may be gradually introduced. When the latter is given, the meat should be reduced to a pulp by repeated passages through a mincing machine and warmed by floating for five or ten minutes in a saucer placed on boiling water, the warming being repeated several times and until the meat loses its raw appearance. In this condition it is not unpalatable.

At first an ounce or two of meat so prepared is given every three or four hours, but if it agrees the quantity should be gradually increased and the intervals between the meals lengthened, until a pound or more is consumed in the twenty-four hours in three or four meals.

Very dry, thin, crisp toast may be added to these meals but water should not be drunk until at least two hours after the meal. It is advisable to give the water as hot as can be swallowed ; in no case should it be taken in large draughts at a time ; it must be sipped slowly.

After several days or weeks of this diet it may be temporarily suspended, and an attempt made once more to resume the milk or a mixed diet, but it is well to allow several hours to intervene between the abandonment of the one and the introduction of the other. When given together meat and milk seldom suit ; but alternating the two every few days sometimes proves successful when the prolonged insistence on one alone proves a failure.

The return to normal diet after a course of meat treatment should be as gradual and tentative as after the milk treatment.

III. The fruit treatment.—One of the most important recent advances in the practical management of sprue is the introduction of the strawberry as an adjuvant to the milk treatment. A diet of milk and strawberries, the amounts of both being gradually raised to 6 pints of the former and 3 lb. of the latter, together with the precautions already insisted on, constitutes on the whole the most generally successful treatment of sprue, sometimes, apparently, leading to a rapid and permanent cure.

When good strawberries are not obtainable the best, though a somewhat inferior, substitute is the banana. Only ripe fruit must be chosen ; rotten and unripe fruit being carefully rejected. The fruit must be reduced to a pulp and thoroughly incorporated with the milk.

In Java, where sprue is endemic and particularly virulent, a diet of fruit alone is sometimes employed, and it is said with success. In Europe what is known as the grape cure is occasionally practised.

In Java, when the fruit treatment is adopted most fruits, including bottled fruits, are allowed, the very acid fruits such as pineapples, the members of the citron family, and extremely fibrous, hard, or dense fruit alone being interdicted. No other food is permitted until all symptoms of the disease disappear or the treatment has proved manifestly unsuitable. We have had no experience of this apparently somewhat heroic method, but van der Burgh and others vouch for its efficacy in a proportion of cases that had resisted other methods.

IV. The mixed diet treatment is a combination of the preceding methods on the lines already indicated.

HILL DIARRHŒA

The treatment of hill diarrhœa is practically the same as for sprue. Bichloride of mercury is generally prescribed as an intestinal antiseptic, and the milk is peptonized or lactopeptin or ingluvin given along with it. The buttermilk or lactic acid ferment treatment seems worth a trial in this disease, for it is one in which bacterial decomposition of food is a specially prominent feature.

INDEX

6